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CONGENITAL BONE SYPHILIS

PRELIMINARY REPORT; ROENTGENOLOGIC STUDY WITH NOTES ON THE HISTOLOGY AND PATHOLOGY OF THE CONDITION*

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THE diagnosis of congenital syphilis is frequently difficult because of the multiplicity of the clinical signs, no one of which is invariably present. We cannot depend upon the Wassermann reaction. The most reliable diagnostic procedure is the roentgen examination of the bones. If the child has congenital syphilis, the roentgenogram of at least some of the bones is almost invariably positive. In view of the increased interest which has recently been taken in the pathology of the fetus and the infant, and the fact that very few clinicians appreciate the value of the roentgen diagnosis in congenital syphilis, we have attempted to review the literature, correlate the normal and abnormal bone changes as studied histologically with those shown on the roentgenogram and as far as possible have divided the abnormal changes into stages for ease of interpretation and description. We have made an attempt to draw some conclusions as to the effect of specific therapy. This paper has been limited to the early cases of congenital syphilis, and late syphilis (syphilitica tarda) will not be considered.

The roentgen appearances of the pathology of congenital syphilis are difficult to understand unless one has a thorough knowledge of the histology of bone development.

DEVELOPMENT OF BONE

In order that one may easily grasp the pathological process found in congenital syphilis, a brief description of the normal ossification of bone will be reviewed. The authors have procured this information in its entirety from Piersol's,[26] Schafer's,[27] Gray's,[16] and Wimberger's[42] writings on this subject. It is appreciated that, at the present time, there are many among the experimental anatomists who believe that the entire chapter on the development of bone will have to be rewritten, because of recently evolved theories not known to the authors of our accepted textbooks at times of writing. We have omitted, however, these revised conceptions of bone development and have confined our efforts to an outline similar to that found in our textbooks.

Ossification of bones takes place by two methods: *endochondral* and *intramembranous* bone development. *Endochondral* development is that process in which the primary ossification occurs in cartilage. By far the greatest number of bones found in the human skeleton develop from masses of embryonal cartilage. *Intra-*

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membranous bone development is that process in which the primary ossification occurs within layers of connective tissue. The bones of the vault and most of the facial bones develop by this method. The two processes are so closely associated in the development of all bones that little attempt will be made to differentiate them; thus, for instance, in the same bone, ossification of the periosteal membrane is *intramembranous* bone development and ossification in the cartilaginous shaft is *endochondral* development.

There are two important processes in normal ossification of the long bones:

(*a*) Growth in length by epiphyseal ossification at the ends of the diaphysis.

(*b*) Growth in thickness by periosteal and endosteal ossification. The epiphyseal ossification is much greater than the periosteal and is therefore usually the location of the greatest change when any pathological process tends to delay the normal development of bone.

In the embryo, the diaphyses and the epiphyses consist of embryonal cartilage invested by an immature form of perichondrium or primary periosteum from which proceed entirely the elements actively engaged in the production of the osseous tissue. The primary periosteum consists of three distinct layers: an outer or fibrous layer; an inner or osteogenetic layer, which is rich in cells, from which the bone elements, osteoclasts and osteoblasts arise, and a middle or vascular layer located between the outer fibrous and the inner osteogenetic layer, which plays an important future rôle in the blood supply of the bone.

The initial changes appear within the embryonal cartilage at points subsequently to be known as the *centers of ossification*, which are located about the middle of the shaft. The early changes are enlargement of the cartilage cells and the deposition of lime salts in the intercellular matrix. When the cartilage cells have acquired their maximum growth, they begin to show evidence of impaired vitality. Coincident with these intracartilaginous changes, the periosteum deposits a thin peripheral layer of bone, and small budlike processes of osteoblastic tissue extend from the osteogenetic layers into the embryonal cartilage, having been preceded by blood vessels. Accompanying this penetration of osteoblastic tissue there is an absorption of the less resistant cartilage cells in the center of ossification. This area of absorption ultimately forms a space called the primary marrow cavity which now occupies the center of ossification and contains the direct continuation of the cells of the osteogenetic layer of the periosteum. The tissue contained in the primary marrow cavity is called primary marrow and it contributes the cellular elements upon which a double rôle devolves, to produce osseous tissue and to remove embryonal cartilage. Beyond the immediate limits of the primary marrow cavity the cartilage cells in turn repeat the preparatory stages described above under the same influence, but in addition often exhibit a conspicuous rearrangement whereby they form columnar groups separated by calcified matrix. This belt is called the *zone of preparatory or temporary calcification* and is best seen at the diaphyseal ends of the bone.

For sake of brevity and ease of description, a longitudinal section through the long axis of the growing end of the bone will be taken as an example, and it shows the following layers of cells extending from the joint side toward the diaphysis. The epiphysis before the appearance of a center of ossification is made up, as in the diaphysis, entirely of cartilage which is termed resting cartilage. The resting cartilage of the epiphysis constitutes the entire area up to the diaphyso-epiphyseal junction. Just at the diaphyso-epiphyseal junction there is a layer of cartilage in which the cells become increasingly larger and arrange themselves in columns extending down towards the diaphysis, the long columns of the cartilage cells lying parallel to the long axis of the bone. The cartilage cells enlarge and the preliminary deposition of calcium takes place in the intercellular matrix in the portion nearest the advancing ossification of the shaft. This belt is called the zone of proliferating cartilage or zone of temporary calcification, and is always definite as a sharp line of demarcation. Its regular arrangement according

to authors quoted by Wimberger[42] depends upon the arrangement of the cartilage canals containing blood vessels, which percolate between the layers of cells in the proliferating cartilage in a regular series of branches at right angles to the long axis of the cartilage. The branching blood vessels which run parallel to one another and axially upon ends from the marrow cavity break through the cross dividing walls around the cartilage cells (the absorption of the cartilage cells being accomplished probably through the agency of *some cells that accompany the blood vessels*) so that longitudinal walls of calcified cartilage remain free and isolated in the marrow cavity (which now extends largely throughout the diaphysis). On these longitudinal walls the osteoblasts arrange themselves (and form young osseous tissue), being brought there by the blood vessels from the bone marrow. Thus a column of cartilaginous tissue is replaced by osseous structure. This framework constitutes the primary spongy or cancellous bone and this area is termed the framework marrow zone. It is called primary because subsequently all or most of it is absorbed by osteoclasts, and then reformed by osteoblasts. The reformed spongy bone is called secondary spongiosa, a permanent structure. The spaces between the osseous trabeculae are filled with marrow which contains blood vessels, osteoclasts, osteoblasts, lymphoid tissue, and other specialized cells (Fig. 1).

Summary of the zones from joint towards diaphysis:

(*a*) Resting cartilage.
(*b*) Proliferating cartilage.
(*c*) Zone of temporary calcification.
(*d*) Framework marrow zone (spongiosa).

An excellent summary of the gross appearance of the above zones has been outlined by Holland[34] which is as follows:

"Cut surface of a longitudinal section of a fresh, normal, long bone of the infant from an epiphyseal cartilage towards the diaphyses the following zones can be recognized.

"1. White, flat, hard cartilage, corresponding to the portion in which growth in length and breadth of cartilage proceeds.

"2. A zone of more slaty and translucent, very slightly bulged, softer cartilage, corresponding to the portion of the cartilage in which, as the first preparatory changes for ossification from the diaphysis, the cells have multiplied, have arranged themselves in columns, and have enlarged at the expense of the matrix.

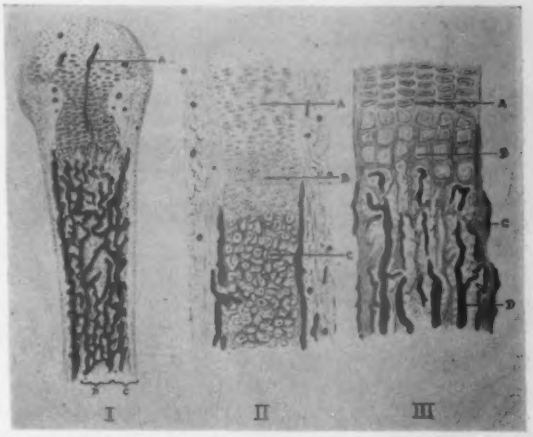

Fig. 1. Modification from Schäfer. Normal ossification of bone.

I. Longitudinal section through the upper half of the decalcified humerus of a fetal sheep showing the arrangement of cartilage cells in the epiphysis, bone trabeculae in the spongiosa and blood supply.
(A) The arterial vessel probably supplies the cellular elements that produce the center of ossification in the epiphysis.
(B) The part of the bone primarily ossified in cartilage.
(C) The part of the bone ossified in membrane.

II.
(A) Resting cartilage zone.
(B) Calcified cartilage including proliferating and columnar cartilage cells.
(C) Framework marrow zone.

III.
(A) Cartilage cells surrounded by calcified matrix.
(B) Degenerating cartilage cells.
(C) Osseous trabeculae.
(D) Vascular loops.

"3. An opaque yellow, often almost white line corresponding to that portion of the cartilage, in which, as the final preparatory change, the matrix has undergone "provisional" calcification, but into which the vascular loops from the medulla have not yet advanced.

"4. The deep red medulla of the diaphysis. Further on close inspection a few delicate vessels may be recognized in the cartilage, close to the diaphysis. *Microscopic* examination shows that the cartilage is permeated by vessels which lie in canals, which have the following arrangement. Vessels pass transversely inward from the perichondrium at regular intervals, which become wider as the diaphysis is approached, to anastomose in the midline; other vessels pass vertically from these trans-

verse arches uniting the transverse arches with one another and ultimately with vessels of the diaphysis. The vessels increase in size toward the diaphysis; in the rib the largest vertical vessels lie in the center of the cartilage.

"The colouration mentioned above becomes to a large extent obscured by hemolysis in the macerated fetus. The yellow line of provisional calcification remains distinct. It stretches unbroken from one side of the bone to the other. It varies a little in depth—that is, in measurement from the epiphysis to diaphysis—at different ages, in different bones and in different portions of some epiphyses, being deepest when the growth is most active. Its measurement is almost invariably ½ mm." (This corresponds to the sharp line at the end of the diaphysis, as shown in the roentgenogram.)

After the center of ossification develops in the epiphyseal cartilage, the arrangement of the zones is slightly different. It is always well to bear in mind *that except on the side of the epiphysis which is turned toward the advancing ossification of the shaft, the cartilage cells do not* become arranged in long columns in the manner described above. Otherwise, we have assumed that the ossification of the epiphysis proceeds in a manner similar to that of the diaphysis. We have found no authentic statement as to the origin of the ossification center in the epiphysis. In attempting to solve this problem, a study of diagnosis in Schäfer's[27] diagrams suggested that a vessel derived from the diaphysis carried the essential elements. In case of epiphyseal separation or other disturbance of this circulation, transverse chondral vessels assume the rôle. Therefore, the zones from the joint line would be as follows:

(*a*) Resting cartilage.
(*b*) Center of ossification
(*c*) Resting cartilage.
(*d*) Columnar or proliferating cartilage cells.
(*e*) Temporary zone of calcification.
(*f*) Framework marrow zone (spongiosa).

Blood Vessels. The generous blood supply of bones is arranged as two sets of vessels, the *periosteal* and *medullary*. The former constitutes an external network within the periosteum from which, on the one hand, minute twigs enter the subjacent compact substance through channels (Volkmann's canals) communicating with the Haversian canals, within which they anastomose with vessels derived from the medullary system; additional vessels, on the other hand, pass to the cancellated tissue occupying the ends of the bone.

ROENTGENOLOGIC APPEARANCE OF NORMAL BONE

If one examines a roentgenogram of a long bone before the development of centers of ossification in the epiphyses, the following features will be observed: The diaphysis appears as a cylinder with a thick, dense wall or cortex in its middle portion. This gradually fades into a thin line at the diaphyso-epiphyseal junction. It surrounds a less dense cavity, the marrow cavity, which at the ends is broken up by the regular network or trabeculation, called the spongy bone. At the diaphyso-epiphyseal junction there is a narrow, unbroken, dense line about 1 mm. in width which is called the zone of temporary calcification and corresponds to the limit of advancing ossification. It is *most important* because of the changes which occur here in such diseases as rickets, scurvy, congenital syphilis and acute leucemia. This is often called the epiphyseal line in medical literature, but this term has been applied in such a variable and confusing manner that we recommend the term *diaphyso-epiphyseal line* or possibly *metaphysis*. The epiphyseal cartilage is not usually seen in the roentgenogram. After a center of ossification develops a faint shadow of the epiphyseal cartilage in addition to the ossified center can usually be seen on the roentgenograms showing excellent soft tissue detail. The periosteum of normal bone is not visible. If it is visible, there is always some underlying pathological change.

CONGENITAL SYPHILIS

Pathology. There has been a considerable amount of investigation relative to the pathology of congenital syphilis, the most outstanding of which has been that by Wegner[40] and Holland,[34] and we have quoted freely from their writings.

In 1870, Wegner[40] described the changes occurring in congenital syphilis mainly as variations from the normal occurring at the diaphyso-epiphyseal junction, and he called this condition *syphilitic osteochondritis*. Syphilis may, however, give rise to inflammatory changes also in the diaphysis at a distance from the epiphysis, or in the periosteum (periostitis syphilitica).

The effect of syphilitic osteochondritis upon the normal zones, previously described above, varies according to the severity of the injury to the normal tissues by the spirochetes and their toxins, and these changes have been divided by Wegner[40] into three stages depending entirely upon the degree (Fig. 2).

Osteochondritis

First Stage. The temporary zone of calcification is increased in thickness, the cartilage cells continue to proliferate, and there is no cessation of the normal changes except retardation of the ossification process. This obviously results in the yellow zone of temporary calcification becoming abnormally wide, and it may measure as much as 2 or more millimeters in width. Holland[34] states that "*in early lesions there may be no recognizable abnormality;* the junction of the epiphysis and diaphysis, then, remains regular and unbroken. When the increase of the zone of calcification is slight and no other changes are present, then, diagnosis, even with the microscope is difficult, unless the spirochetes can be deomonstrated."

Ossification of the temporary zone of calcification is checked to a large extent throughout most of the diaphyso-epiphyseal junction, but it may continue at the sides of several of the *larger* vertical vessels which unite the epiphysis and diaphysis. In these particular regions, therefore, the temporary zone of calcification becomes narrow and consequently the diaphyseal border of the zone is notched, irregular, and serrated in appearance. Wegner[40] states that this zone has a pinkish white, glistening appearance and is very brittle. These changes can be readily demonstrated by the roentgenogram as will be shown later.

Summary.

(*a*) Increased growth of cartilage cells.

(*b*) Temporary calcification increased.

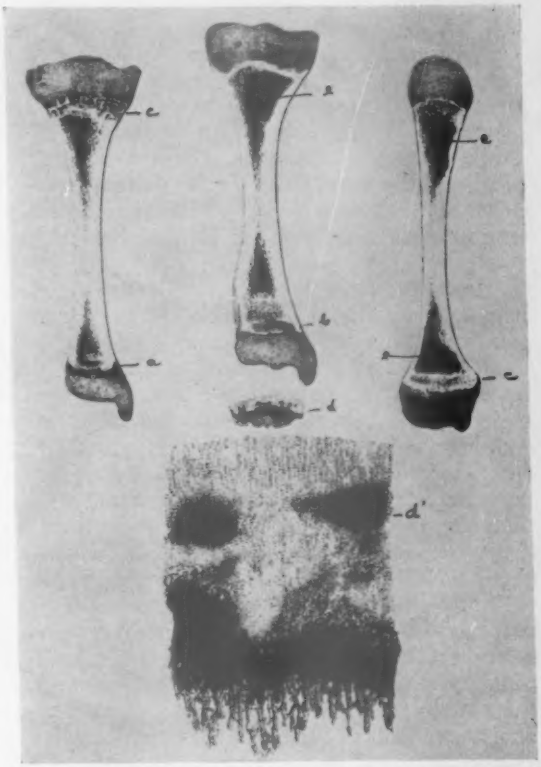

Fig. 2. From Wegner. Pathological changes in congenital syphilis. (*a*) First stage osteochondritis; (*b*) second stage osteochondritis; (*c*) third stage osteochondritis; (*d*) low power magnification of second stage osteochondritis. Note the irregularity of the zone of temporary calcification; (d^1) high power magnification of the same field. Islands of calcified and ossified cartilage are readily seen; (*e*) second stage diaphysitis with punched-out areas or localized areas of osteomyelitis.

(*c*) Ossification decreased.

Second Stage. The cartilage-cell proliferation becomes more marked towards the joint. There is increased calcification of the intercellular cartilage matrix, the zone of temporary calcification now measures about 4 mm. in width. The ossification process is still retarded. Holland's[34] description of this stage is excellent and is quoted in its entirety.

"Owing to curtailment of the normal vascular supply, portions of the epiphyseal cartilage may become degenerate and not undergo provisional calcification and subsequent ossification. The vertical vessels, however, which

unite the cartilage with the diaphysis are relatively large vessels, and the blood supply from these are less likely to be cut off. Provisional calcification and subsequent ossification usually proceed, therefore around some, at any rate, of these.

"In consequence, narrow processes, or broader tongues, of red marrow project from the diaphysis into the epiphyseal cartilage and alternate with tongues of cartilage which project into the diaphysis. The line of junction of the epiphysis with the diaphysis then appears dentate, and the zone of provisional calcification follows the irregular line of interlocking teeth.

"Further, as growth proceeds the level at which provisional calcification should normally take place may reach transverse chondral vessels of which the blood supply has not been interfered with. Around these vessels, in the epiphysis beyond the degenerate portions of cartilage, calcification, and subsequent ossification take place in due course. This leads to the occurrence, in the epiphyseal cartilage at a distance from the main epiphyseal limit of diaphyses, of red streaks and dots which are each bordered by a narrow zone of yellow calcification. Transverse chondral vessels have become visible to the naked eye, and moreover have become surrounded by a visible zone of calcification. Now, not only is the junction of the diaphysis with the epiphysis dentate but transverse zones of provisional calcification are seen at different levels. The disturbance of the normal pattern is extreme.

"The cartilage lying upon the deepened zone of provisional calcification may not be interrupted by vertical vessels surrounded by provisional calcification. Then calcification preparatory for ossification commences in the cartilage about a transverse vascular arch at the time it should normally appear at this arch. When this takes place two zones of provisional calcification separated by a zone of cartilage are seen. Ossification may then proceed toward the epiphysis from this transverse vascular arch. In this way a more remarkable appearance is produced—a yellow, usually irregular line of provisional calcification is followed by a zone of red marrow, in which osseous trabeculae can be felt with the point of the scalpel, and this red marrow is separated from the red diaphyses by a second—the original, yellow, abnormally deep—zone of provisional calcification."

Wegner[40] compares this stage to rickets. The zone has a bluish transparent color, very soft consistency, and cuts like gelatin.

Summary.

(*a*) Further increase in the cartilage cells (zone of proliferation).

(*b*) Further increase in the zone of temporary calcification.

(*c*) Ossification decreased in the zone of primary spongiosa.

(*d*) Occurrence of second zone of temporary calcification just distal to primary zone of temporary calcification.

(*e*) Diaphyso-epiphyseal junction more serrated and irregular.

Third Stage. In this stage there is a further progression of the osteochondritis. In addition, there is evidence of diaphysitis and periostitis.

Added to the changes seen in the second stage there is a definite fibrosis present; in fact, fibrosis is seen by the microscope in all but the slightest and earliest lesions. Holland's[34] conception of this stage is as follows:

Fibrosis may affect the marrow of the metaphyses (diaphyso-epiphyseal junction), or of the canals in the cartilage or of both. In advanced intense inflammations, fibrosis is followed by the development of a dense granulation tissue. In the metaphyses, formation of such granulation tissue results in necrosis with erosion by osteoclasts of the trabeculae of calcified cartilage and bone. The punched-out areas and the irregular rarefaction of the diaphysis as seen on the roentgenogram is the result of the process. When the cartilaginous canals are affected they become greatly widened. The granulation tissue may undergo caseation and softening. The epiphyses may become separated from the diaphyses by a transverse zone of granulation tissue in which trabeculae of calcified cartilage and bone have been eroded; or the epiphyseal cartilage may be divided by a zone of granulation tissue. If such granulation tissue undergoes softening the osseous structure may be entirely destroyed which may result in an infraction of the diaphysis, or the epiphyseal cartilage is divided completely at a short distance from the epiphyseal-diaphyseal junction. Even if the granulation tissue has not softened, partial or complete separation at such spots is likely to recur during life

or in the manipulation required for removal of the bone.

Fibrosis is of greatest assistance in the macroscopic and microscopic recognition of syphilitic osteochondritis. It is the earliest pathological change in congenital syphilis. If the process progresses, the next pathological change is granulation tissue formation due to the disturbance of the blood supply. When slight fibrosis is present in the metaphysis, the marrow in the metaphysis appears to the naked eye more compact and paler than in the remainder of the diaphysis. The affected metaphysis may feel gritty when tested with the point of a scalpel. It may be pink, gray or pale yellow owing to the presence of numerous yellow trabeculae of calcified cartilage in a gray fibrous matrix. More advanced fibrosis appears slaty gray or yellowish, gelatinous and slightly bulged, and feels soft owing to the erosion of calcified cartilage and bone. When slight fibrosis is present in the epiphyseal cartilage the vascular canals are more conspicuous than normally. When advanced fibrosis is present, pink, gray or yellowish strands interrupt the cartilage in the sides of the canal.

Wegner[40] states that after granulation tissue has replaced the normal vasculature, there may be actual pus formation which corresponds to the softening described by Holland.[34] This stage probably corresponds to the condition recognized and described by Parrot[23] in 1871 as Parrot's pseudoparalysis which is always associated with epiphyseal separation in congenital syphilis. Valleix,[35] in 1834, reported a case demonstrating this process, the condition not being recognized until after autopsy.

The coherence of the tissues at this zone is very weak, and has been described as an epiphyseal separation. Our conception is however that the resultant deformity is due to an infraction of the diaphysis just proximal to the epiphyseal cartilage.

Summary.

(*a*) Abnormal cartilage cell proliferation which causes slight swelling of the epiphysis.

(*b*) Widening of the zone of temporary calcification, with occurrence of secondary zones of calcification.

(*c*) Retardation of the transference of calcified cartilage into bone.

(*d*) Fibrosis and granulation tissue, with subsequent necrosis in the marrow at the diaphyso-epiphyseal junction, which causes weakening of the bone at this point, with possible subsequent infraction of the diaphysis (or the so-called epiphyseal separation).

(*e*) The outermost cells near the perichondrium are more regular and the calcified zone is more regular than near the center.

(*f*) The chondral and vascular canals are enlarged, the vessels are few and irregular.

Diaphysitis

It has been our feeling that possibly diaphysitis occurs more frequently than is commonly stated. A number of fetuses or infants that we have had occasion to examine roentgenographically show nothing but an increased density of all of the bones. It is an experimental fact that decreased vascularization of the diaphysis causes increased calcification. Realizing this we believed that the appearance we were seeing was an early stage of diaphysitis, which might ultimately become areas of focal necrosis, if the disease were allowed to progress.

Virchow[38] called rickets "parenchymatous bone inflammation." Wegner[40] called congenital syphilis "osteochondritis" or "cartilage inflammation." In rickets, there is increased vascularization of the tissues with diminished calcification; in syphilis there is diminished vascularization and increased calcification which may be general. Holland[34] says:

> "Focal areas of syphilitic inflammation occur with considerable frequency in the medulla of the diaphysis at a distance from the epiphysis. This fibrosis is associated first with cessation of deposit of bone and later with erosion of trabeculae of bone and calcified cartilage present. In early stages the areas of fibrosis are seen by the naked eye as paler, pink areas in the red marrow of the diaphysis, in later stages the granulation tissue is slaty blue or yellowish, frequently gelatinous, and the affected area feels soft."

Periostitis

This lesion usually accompanies advanced osteochondritis. Apparently it rarely occurs alone. A layer of bone (young

osteoid tissue), red marrow and rarely granulation tissue is deposited outside the cortex under the periosteum. It is readily recognized by the naked eye and is similar to the same zone which occurs in rickets.

Congenital syphilis of the bones is due to the local presence of spirochetes or their toxins. The older the child, the fewer the bones that are affected. In the fetus, the infection is widespread, but not necessarily general. Not all of the bones are affected, the femur, tibia, humerus, and rib, being the sites of election. Alexander[1] has demonstrated syphilis in the scapulae, vertebrae, skull and pelvis with less frequency. Another feature that should be stressed is the occurrence of various stages of infection in the same fetus or infant, one bone showing the first stage, and another the third stage.

Syphilis in the adult is not necessarily transmitted to all of the offspring, as shown by Van der Bogert[36] and Jeans.[18] Van der Bogert reports syphilis in one of twins, the other child being entirely normal. It is not known whether the early manifestations of congenital syphilis heal and then later develop the manifestations found in late syphilis.

ROENTGENOLOGIC CONSIDERATIONS

In 1911, Holt[17] stated that in a syphilitic fetus, a still-born child or one dying soon after birth, the changes in the bones are more uniformly present than any other lesions. It has been recognized that bone lesions are associated frequently with congenital syphilis, and may be the only evidence of the disease. Valleix[35] in 1834, Wegner[40] in 1870, Parrot[23] in 1871, Taylor[33] in 1874, and later writers as Fraenkel,[13] Wallace,[39] and many others, noted and described the pathology of the bone lesions of congenital syphilis. The pathology of the condition had been thoroughly studied prior to the advent of roentgenology. Since that time, however, relatively little effort has been made to correlate the pathological and roentgenological appearances.

Shipley, Pearson and their coworkers[20] regard positive Wassermann reactions as specific, but negative Wassermann reactions are no longer allowed to free the newborn child of luetic stigmata until after the age of two to four months. They state further that the clinical diagnosis of syphilis in the new-born is difficult since the clinical symptoms of the disease may be, or, in fact, are usually entirely absent in the child until several weeks after birth. Moreover, a mother without a single clinical manifestation or any serological indication of spirochetal infection may give birth to a luetic infant.

In spite of these observations numerous articles [6,15,22,31] have recently been written on the diagnosis and treatment of syphilis, in which the roentgen manifestations are either not considered, or are only casually mentioned. It is indeed surprising that the roentgen examination is not used more often as an aid in the diagnosis of cases suspected as being congenital syphilis.

The incidence of congenital syphilis is high enough to justify every roentgenologist in thoroughly familiarizing himself with the roentgen manifestations. Christie[7] evidently realized this in the preparation of a recent excellent editorial on syphilitic osteochondritis. The disease is not limited to large metropolitan centers. Browning[4] states that the incidence of congenital syphilis in the group studied by him was 10 per cent. Williams[41] analyzed 10,000 consecutive pregnancies in which there were 705 still-births; of these 26 per cent had congenital syphilis; of the children born alive, 3.5 per cent had syphilis. These figures were determined by the presence or absence of positive serological tests, therefore the incidence would probably have been found higher if the infants had been studied roentgenologically. Shipley et al[30] in an examination of 200 infants, still-born or dying soon after birth, found 25 per cent with roentgen evidence of syphilis.

Recently Davidsohn[9] has collected statistics from all over the world (Germany, Czechoslovakia and North America) which show that from 2 to 5 per cent of infants have congenital syphilis. Findlay[12] found bone lesions in 25 per cent of cases of congenital syphilis studied by him. Dennie[10] in a study of 50 cases, stated that 40 per cent had no other signs except the bone lesions.

Burke[5] makes the startling statement that in England there are 30,000 still-births and deaths from lues in children annually.

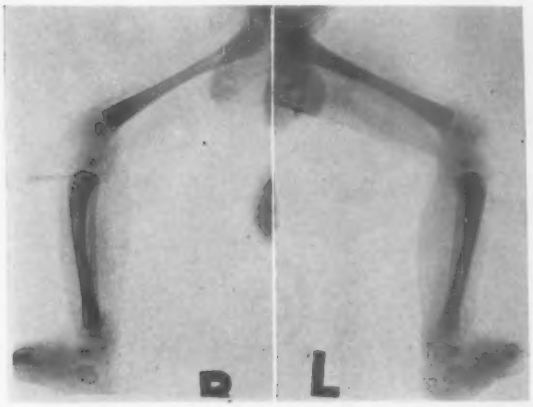

Fig. 3. There are localized areas of rarefaction in the tarsal bones and the periphery of the osseous center is increased in density. In addition the long bones of both lower extremities are increased in density and this is regarded as first stage diaphysitis.

Congenital syphilis may be demonstrated on the roentgenogram as osteochondritis, periostitis or diaphysitis just as it can be demonstrated pathologically. Either one or all of these conditions may be found in the same patient. Osteochondritis may be divided into three stages.

words, an active child. This observation was also made by Shipley and Pearson.[30]

As stated above, congenital syphilis of the bones is not a general systemic infection of the infant, but is due to the local presence of the spirochetes or their toxins. Sutherland and Mitchell[32] suggest that osteochrondritis is a secondary rather than a tertiary lesion because of its ephemeral character. The older the child, the fewer the bones that are affected. In the fetus, the infection is widespread, but is not necessarily general. Therefore, it is not usual to find all of the bones affected. Syphilis may involve one or all of the bones of the body and it should be borne in mind, therefore, that no examination can be regarded as negative until the entire skeleton has been examined. The point of election for the lesions is usually in the bones in which there is more active normal growth. Most authors including Wegner,[40] Findlay,[12] Shipley,[30] and Alexander,[1] agree as to the sites of election, at least as far as osteochrondritis is concerned, and are given in the order of frequency: lower end of the femur, lower end of radius, upper end of tibia, upper end of femur, upper fibula, upper humerus and other bones with less frequency.

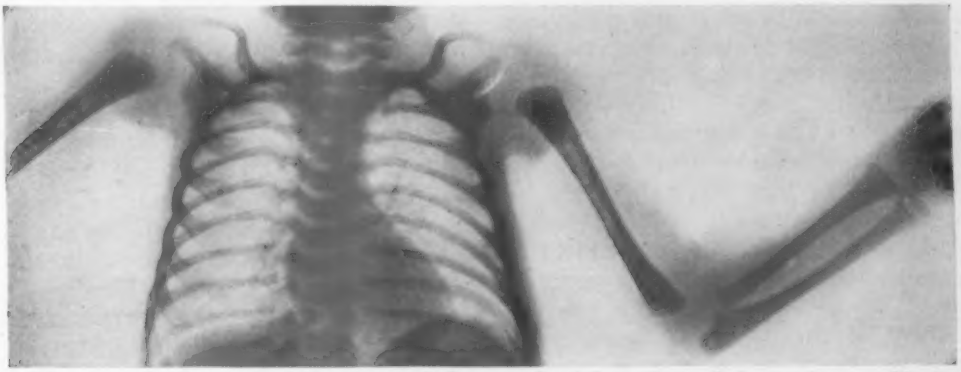

Fig. 4. The zones of temporary calcification at the lower ends of the radius and ulna are increased in density.

Periostitis and diaphysitis usually accompany the third stage of osteochrondritis, or they may occur individually as the only evidence of the infection, but this is relatively rare. Periostitis is rarely seen in the still-born; more often, it occurs in the *older infant*, one that is using the muscles of the leg and arm or, in other

Osteochondritis

The three pathological stages of osteochondritis of Wegner have previously been described.

Epiphysitis. The subject of epiphysitis has not been discussed thoroughly by any of the pathologists that we have had occasion to review, and we have been

unable to find any reference to the effect of congenital syphilis on the center of ossification in either pathological or roentgenological literature. The appearances of epiphyseal involvement herein described are, therefore, based entirely upon the study of our own series of cases. For convenience, epiphysitis will be divided into three stages and discussed with osteochondritis.

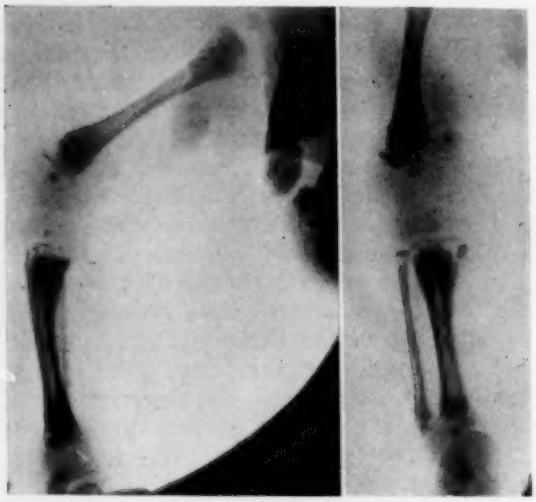

Fig. 5. The periphery of the tarsal bones is considerably increased in density with areas of rarefaction in the osseous centers. In addition there is evidence of third stage osteochondritis in the long bones with a slight amount of periosteal reaction. There has been a diaphyseal infraction of the lower end of the femur.

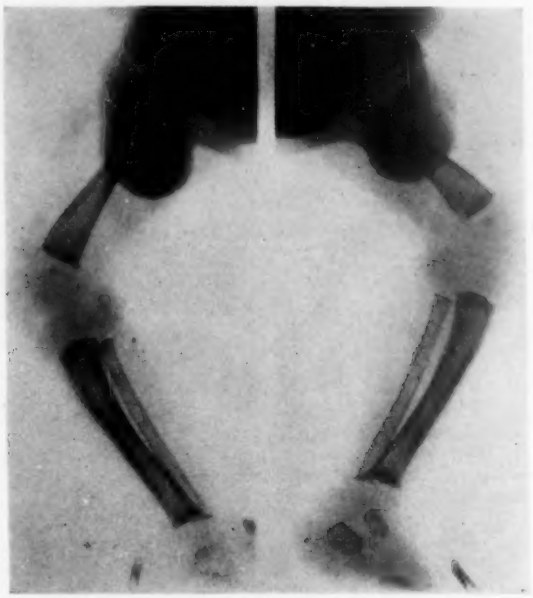

Fig. 6. Note the two zones of temporary calcification at the lower ends of the tibiae and femora. The zones of temporary calcification at the diaphyso-epiphyseal junction are serrated and irregular.

First Stage.

1. Swelling of the epiphyseal cartilage, due to the proliferation of the cartilage cells. This may or may not be evident on the roentgenogram, the interpretation thereof depending upon the possibility of comparisons with the uninvolved opposite member. This of course is before the development of the center of ossification. After the development of the centers in either the epiphysis, tarsal, or carpal bones, changes may take place within the ossified portion. The first abnormal appearances are localized areas of rarefaction giving the impression that holes have been made in the osseous center. The periphery of the center becomes increased in density, this appearance being very similar to that of the ring described by Wimberger in scurvy (see Fig. 3).

2. Increase in the width and density of the zone of temporary calcification. Normally the zone of temporary calcification is evidenced on the roentgenogram by a regular, unbroken line of increased density, 0.5 to 1 mm. in width at the diaphyso-epiphyseal junction. In congenital syphilis it is increased to approximately 2 mm. in width (see Fig. 4).

3. Ossification of the calcified zone or primary spongiosa decreased except around developed vessels, thus making an irregular border more evident on the diaphyseal side of the zone of temporary calcification.

Second Stage.

1. Further increase in the size of the epiphyseal cartilage. Here again this finding is relative and can only be demonstrated after comparison with a possible normal on the opposite side. After the development of centers of ossification in the epiphyses and tarsal bones the changes discussed under Stage 1 have advanced. The localized areas of rarefaction are larger and more pronounced. The line of increased density around the periphery of the osseous center increases in density and width, but at one or more points

the dense line may be interrupted, due to the extension of the rarefied areas to the periphery (see Fig. 5).

Fig. 7. Third stage epiphysitis of the tarsal bones. Note the rarefied center, line of increased density and the osteoid zone outside of the zone of increased density.

2. The zone of temporary calcification is increased up to 4 mm. in width.

3. Ossification decreases, giving a more serrated and irregular appearance to the zone of temporary calcification, quite evident on the diaphyseal side of the zone and to a less extent on the epiphyseal side. This irregular appearance is due to ossification proceeding around some of the remaining larger vessels which extend from the diaphysis into the epiphysis.

4. Occurrence of a second zone of temporary calcification on the epiphyseal side just distal to the original zone of temporary calcification. The most likely explanation of this finding is that given by Holland[34] which is to the effect that the cartilage cells lying upon the original zone of temporary calcification may not

Fig. 8. The zone of temporary calcification is wide and the zone of decreased density on the side adjacent to the diaphysis is clearly visible in all of the long bones, especially at the lower ends of the ulna and radius. There has been a diaphyseal infraction at the lower end of the ulna.

be interrupted by vertical vessels surrounded by provisional calcification. In consequence of the growth that proceeds, the level at which temporary calcification should normally take place reaches the transverse chondral vessels, the blood supply of which has not been interfered with. Then calcification preparatory for ossification begins in the cartilage about a transverse vascular arch giving the appearance of two zones of temporary calcification separated by a zone of cartilage from the original widened zone of temporary calcification (Fig. 6).

Third Stage.

In this stage there is a further progression of the process detailed for the

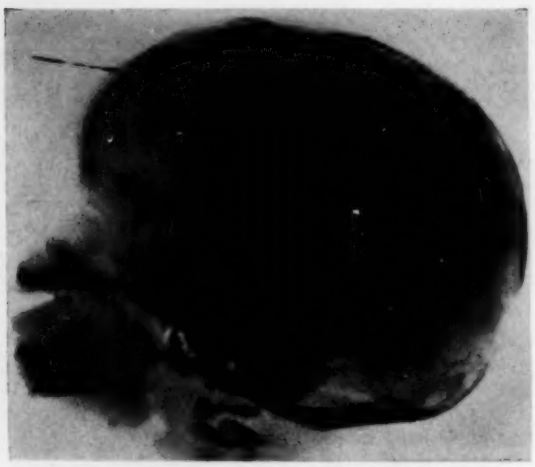

Fig. 9. Necrosing osteitis of the bones of the skull. There is periostitis in the frontal region.

second stage. In addition evidence of periostitis and diaphysitis may be noted.

The changes in the osseous centers of the tarsal bones and the epiphyses are most characteristic in this stage. One can easily see the localized rarefied areas in the osseous centers. The original zone of increased density around the periphery of the center of ossification is surrounded by a narrow zone of lessened density apparently of osteoid tissue. As far as we have been able to discover this appearance is characteristic (see Fig. 7).

Another important change in this stage is the zone of decreased density proximal to the zone of temporary calcification. This is due to the formation of granulation tissue in place of the usual normal vascular supply, with subsequent decrease in ossification and absorption of the old bone. If the process progresses, the bone becomes weak enough to allow infraction of the diaphysis first observed by Fraenkel,[13] and causing the condition called by Parrot[23] "pseudo-paralysis" (Fig. 8). Veeder and Jeans[37] found the incidence of pseudo-paralysis to be 14 in 100 cases. Findlay[12] states that it may be taken as an axiom that "the loss of power in a limb of an infant under six months of age is due to syphilis."

Diaphysitis

Under this heading we have included inflammation of the bones of the vault, vertebrae and pelvic bones except at the epiphyseal regions, and the long and short-long bones. We have attempted to divide the process into two stages, depending upon the severity of the process. It should be remembered that diaphysitis may occur alone, or it may be associated with either osteochondritis or periostitis or both.

First Stage.

Stage of irritation evidenced by increased density of some or all of the bones. This may be the only diagnostic sign of syphilis. At first we were inclined to overlook this finding, but as it occurred frequently in some bones in infants that had other stigmata of the disease we felt justified in suggesting this as the first stage of diaphysitis. Lovett and Wolbach[21] called attention to the fact that if the degree of reaction to the spirochetes or their toxins was slight there would be bone proliferation, if severe, there would be necrosis. The bones of the skull, pelvis and vertebrae may show these changes as definitely as those seen in the long bones (Fig. 3).

Second Stage.

In this stage the process is much advanced and for convenience we will discuss the process in the various bones separately.

In the vault, the process may involve the inner or the outer table or both, and is evidenced as a rarefying or necrosing osteitis. Léri and Cottenot[20] emphasize the fact that osteitis of the inner table of the skull is an important diagnostic sign (Fig. 9).

When the short-long bones, pelvic bones and vertebrae are involved, the appearance may be evidenced as rarefying osteitis or focal necrosis. The pathology of the condition is the formation of fibrosis, interference with blood supply, the formation of granulation tissue, cessation of deposit of bone, and later erosion of the trabeculae of the bone and calcified cartilage already present. The roentgenogram shows an irregular rarefaction or focal necrosis or both.

In the long bones, the process is much more evident. Here the roentgenogram

shows either an irregular rarefaction or focal necrosis or both, sometimes appearing as an ordinary osteomyelitis. Baetjer and

Fig. 10. This patient had a fulminating infection. There is second stage diaphysitis and third stage osteochondritis. All bones show evidence of periostitis. Note the absence of periosteal bone proliferation on the posterior aspect of the femur.

Waters[2] call attention to the diagnostic importance of the punched-out area near the zone of temporary calcification. They also state that luetic infections nearly always produce new bone. While this is true to a large extent in older children *it is not so evident in the young infant* (Figs. 10, 11, 12 and 13).

Another important feature which we regard as evidence of diaphysitis has been noted by Shipley and Pearson.[30] In many of the long bones, the spongiosa near the end of the diaphysis is *cone-shaped*, and is apparently separated from the thin dense cortex by a narrow zone of decreased density, giving it the appearance of being suspended unattached within the cortical cavity (Fig. 14).

Periostitis

This manifestation usually accompanies advanced osteochondritis. Apparently it

Fig. 11. Same case as Figure 10. There has been an infraction of the lower end of the right femur. The epiphyseal cartilages of the femur and tibia are considerably swollen.

rarely occurs alone, and is usually seen in older infants and children. The appearance on the roentgenogram is due to the abnormal deposition of new osteoid tissue beneath the periosteum. In all long bones and the vault this deposition of the bone frequently gives an appearance of perpendicular striation on the roentgenogram. This is because the bone is deposited around the vascular channels extending from the periosteum into the shaft, and it is, therefore, at right angles to the long axis of the bone. Fraenkel[14] states that periostitis is usually present in the ilium but cannot be demonstrated on the roentgenogram. We have noted that there is rarely evidence

of periostitis on the posterior aspect of the femur, possibly because of the arrangement of muscle attachments (Fig. 15).

Fig. 12. Note punched-out area at the upper end of tibia.

On the outer table of the skull there sometimes develop nodes first described by Parrot,[24] and which are called "Parrot's nodes." It is probably an end-result of periostitis. Scott[29] noted the fact that rarely periostitis, elsewhere, may develop into osteophytes as an end-result.

We have regarded dactylitis as evidence of periostitis in the short-long bones. According to Holt,[17] it usually occurs under one year of age, and attacks the metacarpals and metatarsals more frequently than it does the phalanges. The appearance on the roentgenogram is that of a shell of bone surrounding the affected diaphysis, extending from the zone of temporary calcification at the base to the beginning of the epiphyseal cartilage distally. In the first metacarpal and first metatarsal it extends from the epiphyseal cartilage at the base to the epiphyseal cartilage at the distal end. Curiously enough, the new bone is laid down horizontally to the long axis of the shaft, similar to tuberculosis (Fig. 16).

Differential Diagnosis

Christie[7] states, "The roentgen appearance of the osteochondritic process is characteristic and scarcely to be mistaken for any other condition." This statement has been borne out in the study of our cases. The most important diseases to be differentiated are rickets and infantile scurvy. Congenital syphilis is a disease more often found in the new-born or in early infancy, whereas rickets and scurvy rarely occur before the fourth month. The pathological changes in all three conditions

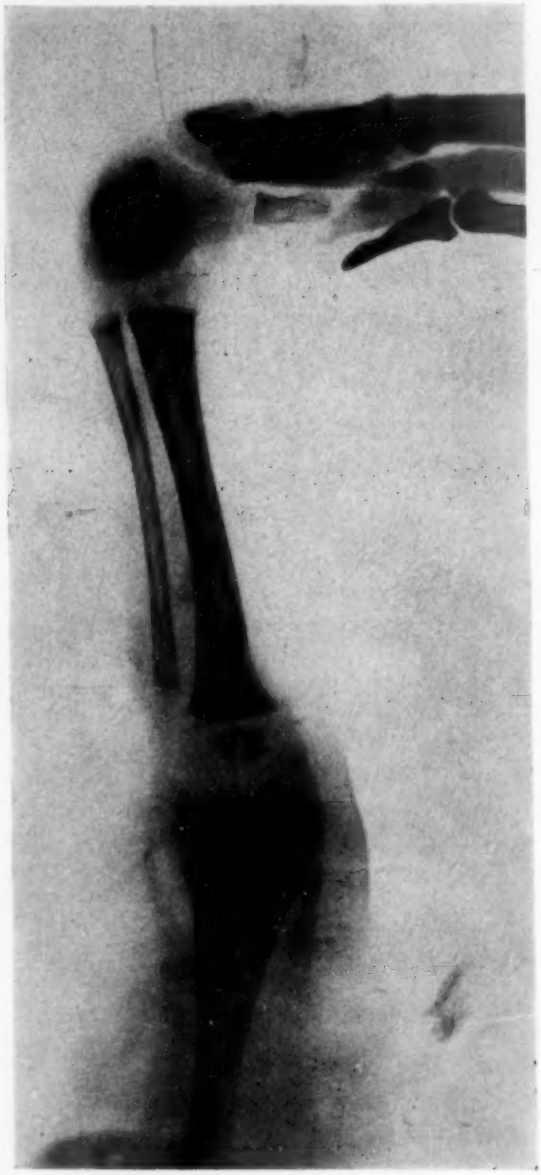

Fig. 13. Same case as shown in Figure 12 six months after specific therapy. The punched-out area has healed and the bone has reformed.

are manifested in the areas of endochondral and periosteal bone growth and each has its characteristic roentgen appearance of

Fig. 14. Second stage diaphysitis with cone-shaped spongiosa in the ends of the diaphyses of the femora and tibiae of both knees.

the endochondral areas. The periosteal changes on the roentgenogram offer more difficulty in differentiation, but the recognition of the endochondral changes will insure the correct diagnosis. The endochondral area includes the epiphysis with the epiphyseal center of ossification when present, the diaphyso-epiphyseal junction, the zone of temporary calcification, and the zone adjacent to it on the shaft side. For convenience of comparison, the essential points of differentiation in the roentgen appearance of (1) the epiphysis will first be discussed, and (2) the appearance of the diaphyso-epiphyseal junction and the zone of temporary calcification with the zone adjacent to it on the shaft side will be compared.

(1) *The Epiphysis.* The resting cartilage of the epiphysis becomes swollen in rickets due to the multiplication of new cells and the increased vascularity in the zone of proliferating cartilage and the columnar zone. Thus in rickets as well as in congenital syphilis the faint outline of the swollen, resting and proliferating cartilage can be seen on roentgenograms of

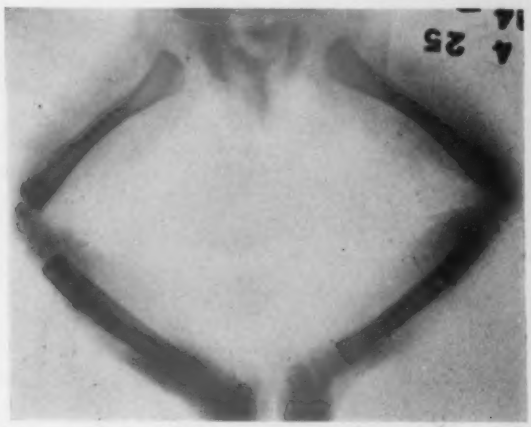

Fig. 15. Periostitis with perpendicular striation of the femora. Note absence of periosteal bone proliferation on the posterior aspect of the femora.

excellent detail. In infantile scurvy, on the contrary, no such appearance can be noted.

The epiphyseal center of ossification in rickets is histologically shown to be broader and more irregular than normal, and on the roentgenogram has a ragged and motheaten periphery. The center itself shows a motheaten appearance. In syphilitic osteochondritis localized areas of rarefaction with an intact, dense periphery of the center are present. In scurvy, the distinguishing characteristic is the dense, encircling ring, described by Wimberger,[43] which is thinner on the shaft side, and more dense on the side toward the joint. Within this ring the center has the characteristic ground glass appearance with a loss of the normal striations.

In healing scurvy, the ring becomes increasingly broader as healing progresses, with a very gradual corresponding decrease in the rarefied area within this ring.

In healing rickets, a new zone of temporary calcification is formed and a layer of osteoid tissue can be seen. This is a typical appearance of healing rickets and should not be mistaken for the osteoid zone of the third stage of osteochondritis.

(2) *The Diaphyso-epiphyseal Junction, the Zone of Temporary Calcification and the Zone Adjacent to it on the Shaft Side.* In rickets the principal histological changes

are seen in the zone of proliferating cartilage and in the columnar zone. The first is increased in size chiefly by the multiplication of new cells and becomes more vascular than normal; the second is affected in the same way to an even greater degree. The changes in the blood vessels of the epiphysis and the endochondral area are marked. Instead of vessels of comparatively small diameter as in normal bone, or reduced or obliterated ones as previously described in syphilis, large vascular channels are formed which are surrounded by medullary spaces. There is an increasing deposition of uncalcified, osteoid bone in place of normal calcified bone. The ossification zone, where the primary spongy or cancellous bone is formed, is broad and very irregular instead of being sharply outlined. Thus, as the rachitic process progresses, uncalcified, osteoid bone is applied in increasing amount, in more or less wide layers, to the trabeculae and the endosteum. Erdheim[11] believes the zone of temporary calcification, in normal ossification, maintains a constant shape and depth during growth, and the rate of absorption of the primary growing cartilage is adjusted correctly in relation to the deposition of lime in the zone of proliferating cartilage. In rickets, absorption goes on very often at a reduced rate. Consequently, the amount and extent of the calcification is correspondingly decreased since the deposition of lime in the proliferating cartilage is dependent on this rate of absorption. As a result the zone of temporary calcification disappears. While this is going on, the normal process of endochondral ossification becomes disorganized, the marrow blood vessels lose their axial alignment and spread irregularly through the zone of proliferating cartilage, and form an irregular network with the vessels of the cartilaginous matrix, between which uncalcified bone cells are deposited.

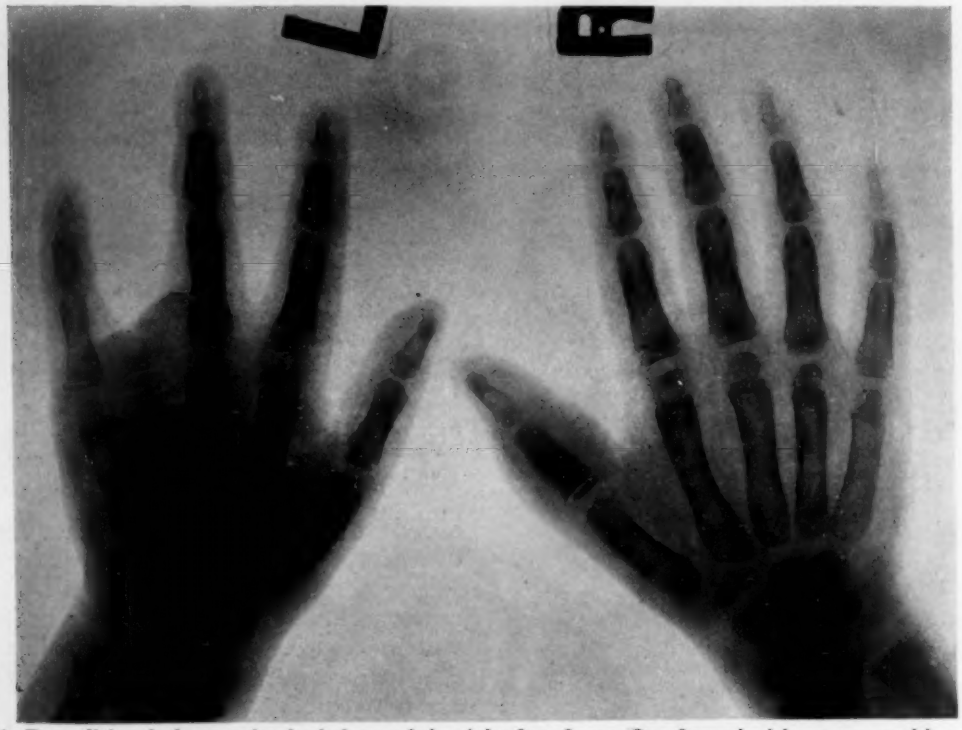

FIG. 16. Dactylitis of the proximal phalanx of the right first finger. One finger had been removed because of a diagnosis of osteosarcoma at another laboratory.

The pathological changes in rickets are, therefore, essentially due to an increased vascularity while those of syphilitic osteo-

chondritis are due to a decreased vascularity.

Wimberger[42] has described two types of florid rickets, the passive and the active, which have distinctive appearances on the roentgenogram. The former is usually found in severe cases, and in comparatively young infants, the child being in a poor state of nutrition, and bodily inactivity, lying on its back and not moving its extremities. This type is characterized on the roentgenogram by the partial or complete disappearance of the zone of temporary calcification and by a rarefied appearance of the entire shaft, the trabeculae having a coarse and exaggerated definition. The active type is found in those children, who in spite of their illness, show a good state of nutrition and of bodily activity. Because of this bodily activity, the active form shows the well-known cupping of the diaphyseal ends which have a broadened and swollen appearance. The distal ends of the ulna, radius and tibia and, less often, the femur, show the most marked cupping. The distal end of the humerus is never concave, but is always convex (Wimberger).[42]

The edge of the cupped area is shown on histological sections as a semicircular envelope which is believed by Wimberger[42] to be due to the calcium protective law of Erdheim.[11] The limited amount of calcium in the rachitic bone is deposited at the periphery, since the long bones suffer the greatest strain at the periphery. Thus the calcium selects for its deposition, from the large amount of osteoid tissue, the site which offers the greatest available strength resulting from its deposition. The cupping on the roentgenogram is thus explained on a mechanical basis. The fraying of the edge of the cupped area is due to thin, half-calcified trabeculae which can be traced into the resting cartilage of the epiphysis. This does not, however, resemble the minute projections into the resting cartilage of the epiphysis in syphilitic osteochondritis and should be easily differentiated.

These pathological changes produce a roentgen appearance which is entirely different from that of congenital syphilis. Instead of the accentuated, broader than normal, line of temporary calcification as in syphilis, there is, in the florid case of rickets which has not yet reached the healing stage, a partial or complete loss of the normal appearing, fairly dense line. Wimberger[42] states that if the disease progresses slowly, the zone of temporary calcification will only gradually disappear. On the diaphyseal side of the zone of temporary calcification, the thinner trabeculae in the florid type disappear, and as the osteoid tissue is formed to an increasing extent, the thicker and coarser trabeculae become blurred and have an irregular appearance. In the active form, the cupping which is characteristic of rickets, serves as an absolute differentiation from syphilis.

As healing progresses in rickets, several changes are to be noted. The deposition of calcium ceases as the rachitic process goes on, and row after row of cartilage cells become added to the rachitic zone. Deposition of cartilage in the process of of repair does not begin at the old cartilage-bone junction but at the place where it would have taken place had rickets not developed, that is, at the end of the zone of rachitic proliferation, the new diaphyso-epiphyseal junction (Wimberger).[42] Thus a new zone of temporary calcification is formed and can be regarded as the first sign of healing in endochondral ossification. Its position depends on that of the cartilage blood vessels which have not been included in the rachitic zone. This new zone of temporary calcification provides a check on the rachitic proliferation in the growing cartilage tissue, and the normal growth of bone makes a beginning from this new zone of temporary calcification. Behind this zone, increasing calcium deposition goes on, in the process of absorption and deposition, and thus the osteoid tissue becomes transformed into bone.

Schmorl[28] has shown that if a relapse occurs, the new line of temporary calcification will be broken through, and the line corresponding to the period of healing will be buried in the widened distal portion of the diaphysis. Occasionally several of these partially or completely buried lines of calcification can be seen, indicating

as many attempts at healing with relapse. If the relapsing form is present, two or more thin, occasionally somewhat broken, transverse lines can be seen on the roentgenogram at the diaphyseal ends, due to the formation of new lines of temporary calcification. These are freshly deposited and remain unabsorbed, while rachitic osteoid tissue lies between and is the cause of the corresponding homogeneous space on the roentgenogram.

As healing progresses the new line of temporary calcification becomes wider and more dense. The rachitic osteoid tissue, between the new and the old lines of temporary calcification shows longitudinal bands which gradually become thicker as calcified tissue replaces the osteoid tissue. As healing progresses still further, the irregular outline of the zone of temporary calcification becomes smoother on the side toward the cartilage. The rachitic zone between the two zones of temporary calcification shows a finely meshed structure and can be distinguished from the old diaphysis which is coarsely meshed. Wimberger[42] states that this appearance may persist for a year or more after the skeleton has apparently otherwise healed.

In infantile scurvy the changes in the endochondral area have been fully described by Pelkan.[25] The proliferating cartilage cells become distorted and mitosis is lacking. The zone of temporary calcification becomes several times broader than normal and is well calcified although much distorted. A zone of greatly weakened bone is found in spongiosa immediately adjacent to the zone of temporary calcification. This weakened zone is due to the few and small blood vessels which apparently do not enter the cartilage to carry on the normal process of resorption. The trabeculae of this weakened zone are of poor staining quality and are no longer covered by osteoblasts. They have received no additional calcium and apparently do not function. The lymphoid marrow is replaced in this zone of greatly weakened bone by framework marrow "Gerüstmark" (Lehndorff).[19] Here, where the marrow should normally have a deep red color, a yellow marrow is found which has lost its gelatinous consistency.

These changes produce on the roentgenogram (1) a broad and uniformly dense and plainly noticeable zone of temporary calcification and (2) a band of decreased density immediately behind the zone of temporary calcification on the shaft side. Instead of the terms "white line" and "Trummerfeldzone" which have been indiscriminately used heretofore to distinguish these zones, we suggest that they be designated as the broadened zone of temporary calcification and the framework marrow zone which admit of no confusion (Bromer).[3]

In the diaphysis, in scurvy, an atrophy of the cortex, with excessive thinning, is readily apparent on the roentgenogram and has been called by Pelkan[25] the pencil point thinning of the cortex. In addition, near the extremities of the diaphyses a loss of fine striations is present which produces the ground glass appearance as also pointed out by Pelkan. Small projections at right angles to the extremities of the diaphyses have been termed lateral spurs and are the limit of the subperiosteal hemorrhages. Fully developed subperiosteal hemorrhages are easily seen.

SUMMARY

The Epiphysis.

1. The outline of the resting and proliferating cartilage in rickets and syphilis is swollen, but in scurvy is of normal size.

2. The epiphyseal center in rickets has a motheaten appearance throughout, with a partial or complete loss of the zone of temporary calcification, i.e., the periphery. In scurvy a very distinct ring shadow is present with the characteristic ground glass appearance of the center within the ring. In syphilis the periphery is intact but localized areas of rarefaction within the center are often present in close position or immediately adjacent to the periphery.

The Diaphyso-epiphyseal Junction, the Zone of Temporary Calcification and the Zone Adjacent to it on the Shaft Side.

1. In rickets the zone of temporary calcification gradually disappears, is always

a thin line, broken through at intervals if wholly absent. In syphilis it persists as a dense broad zone. In scurvy it shows as a very distinct widened and dense zone.

2. In healing rickets a new zone of temporary calcification is formed with a layer of osteoid bone between the new and old zones. In a relapsing case several new zones may be present. In syphilis, a new zone is also formed but there is no characteristically appearing osteoid layer between the zones. In healing scurvy the zone of temporary calcification becomes increasingly denser and wider.

3. In rickets, thick and coarse trabeculae are found in the zone immediately adjacent to the zone of temporary calcification on the shaft side. In syphilis this zone has a more evenly blurred appearance, while in scurvy the framework marrow zone of decreased density can easily be recognized in the cases clinically beyond the latent or subacute stage.

4. Cupping of the diaphyseal ends is present only in rickets. These spring from the frayed out diaphyseal ends as semicircular projections. In scurvy, the lateral spurs or early roentgen evidence of hemorrhage project at a right angle to the shaft at the diaphyseal ends. In syphilis, neither cupping nor lateral spurs can be found.

5. In rickets, the fraying of the end of the cupped area, due to thin, half-calcified trabeculae can be traced at times on the roentgenogram into the resting cartilage of the epiphysis. In syphilis, fine thin projections can be seen occasionally in the first and second stages of osteochondritis with the aid of a magnifying glass. They also extend into the cartilage, but these have a more even, fine and uniform arrangement. In scurvy, the outline of the zone of temporary calcification on the epiphyseal side shows a distinct, sharply outlined margin.

Periosteal changes are present in all three diseases. Periostitis rarely occurs alone in congenital syphilis, usually accompanies advanced osteochondritis, and is more frequent in older infants and children. These characteristics should materially assist in the differential diagnosis. In roentgenograms of excellent quality perpendicular striations in syphilis can be noted. The periosteal change in rickets is a homogeneous osteoid deposition of bone. In scurvy, periosteal thickening is the result of the calcification and disappearance of the subperiosteal hemorrhages. It is a manifestation of the fourth or healing stage (Bromer),[3] and is usually accompanied by the characteristic changes previously described in the epiphyseal centers of ossification. From the study of the cases of this series it seems that the lack of periosteal proliferation in congenital syphilis along the posterior borders of the femur is another diagnostic sign.

ACUTE LEUCEMIA

One of us (Pendergrass) has had an opportunity to study the roentgen appearance of the long bones in a case of acute leucemia. The bones were essentially normal except for an extremely well-marked increase in the width of the zones of temporary calcification. There was no atrophy, rarefaction or any other change in the endochondral areas of bone growth. The blood picture is the pathognomonic sign in establishing the diagnosis. Also. acute leucemia occurs, as a rule, in older children than syphilitic osteochondritis.

EFFECT OF TREATMENT IN CONGENITAL SYPHILIS

Our series of cases has not been under observation for a sufficient length of time to warrant any definite conclusions, and the study of the effect of specific treatment will be incorporated in a later report. In general, our observations in a comparatively small number of cases, have coincided with those of Sutherland and Mitchell.[32] They found that the shadow at the diaphyseal extremity (zone of temporary calcification) became broader and less intense. Trabeculae re-appeared and became more dense in the area of decreased density on the shaft side of the zone of temporary calcification. Irregular densities at the end of the shaft became gradually more regular and normal growth of bone continued. Periosteal changes, they found, were slower in returning to normal. In a few weeks the narrow clear area adjacent to the zone of tem-

porary calcification became less distinct. The longitudinal striations in the thickened periosteum decreased in density and finally the periosteal shadow became narrower. They also stated that the roentgen findings in positive cases disappeared without any treatment and, because of the ephemeral nature of osteochondritis, suggested that it is a secondary lesion.

The periosteum has remained thickened in one of the cases of scurvy studied by one of us for five years after the onset of the disease. In a later communication we hope to be able to state fully the effect of the various forms of treatment on the bone lesions of congenital syphilis, the length of the time necessary for their complete disappearance, and to compare the latter with the period of repair and healing in rickets and scurvy.

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PULMONARY SYPHILIS*

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SYPHILIS of the lung in the adult is unquestionably rarely encountered. However, it is not so rare as pathologists would lead us to believe, and, conversely, not nearly so common as some clinicians and roentgenologists seem to think.

Statistics in the medical literature vary all the way from reports of clinicians of wide experience who state that they have never seen a case, to those of roentgenologists who report 3 per cent of positive or probable lung syphilis picked up in routine examinations of the chest and heart. With such widely divergent results one expects small aid from the existing literature on the subject. A careful study of the literature reveals little that is helpful in the recognition of pulmonary syphilis, either to the roentgenologist or to the clinician. The reasons for this are obvious.

Roentgen diagnosis in all disease has had its inception at the post-mortem table or in the operating room. The extreme difficulty of differentiating tuberculosis and syphilis of the lungs post mortem has made pathologists loath to report lung lesions luetic even when occurring in individuals dying of syphilis elsewhere in their bodies. The *Spirochaeta pallida* is rarely demonstrable in pulmonary syphilis, and in its absence the pathologist is not likely to report syphilis. This conservative attitude undoubtedly accounts for the low incidence of pulmonary syphilis at autopsy and has prevented the literature from being entirely swamped by case reports of pulmonary syphilis, the diagnosis being ofttimes based on nothing more than a positive Wassermann reaction and a cough.

Several factors have contributed to the relatively high incidence of pulmonary syphilis reported by clinicians and occasionally by roentgenologists: (1) The high incidence of syphilis in our ordinary population. Statistics from sanatoria for the treatment of pulmonary tuberculosis show an incidence of from 4 to 9 per cent of positive Wassermann reactions in individuals with definite, uncomplicated, sputum-positive, pulmonary tuberculosis; (2) the fact that a systemic lues does not give immunity to the acute, subacute and chronic pulmonary diseases commonly met with; (3) the belief that any pulmonary process in a syphilitic which undergoes resolution or absorption during antiluetic treatment must necessarily represent a cured case of pulmonary syphilis, and (4) the fact that so few roentgenograms of unquestioned pulmonary syphilis are available that we have as yet no clearly conceived idea of how pulmonary syphilis should or does appear on the roentgen plate.

While medical literature is full of case reports of pulmonary syphilis, very few of the cases are accompanied by roentgenograms. The few which are given almost invariably show such a marked degree of thickening of the pleura over one lung that visualization of a lesion of the parenchyma, even if present, is manifestly impossible. The cases are reported as improved or well following antiluetic therapy, but follow-up plates, when made, almost invariably show no change. This is explained by the authors as bronchostenosis, with resulting collapse of the lung.

While these cases may all represent the late effects of pulmonary syphilis, they

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offer little aid in the recognition of the disease at an earlier period.

Real progress in the roentgen diagnosis of pulmonary syphilis will not be made till roentgenograms of unquestioned pulmonary syphilis both in its early stage and in the later stages with its accompanying complications and sequelae are available for study. To be acceptable, such cases should consist of a series of plates showing the disease progressive without treatment; later plates, after specific therapy, showing retrogression, and still later plates showing a disappearance of the involvement. Naturally such a happy sequence of events is rarely met with or the diagnosis of pulmonary syphilis would have been settled long ago. Exhaustive clinical study will be necessary in such cases to exclude other diseases which might produce the shadows shown on the roentgenogram. In the light of our present knowledge, even a tentative diagnosis of pulmonary syphilis is not warranted until every other possible type of pulmonary disease is excluded. This will, of necessity, call for a period of observation where no type of therapy is given. This will allow many acute and subacute pulmonary consolidations, non-luetic in etiology, to undergo resolution. Bronchoscopic examination will often be necessary to rule out primary new growths. Roentgen therapy will occasionally be instituted to rule out the radiosensitive tumors such as Hodgkin's disease and lymphosarcoma which might be easily confused with syphilis. Pleural effusions occurring in syphilitics should be subjected to microscopic study and animal inoculation before venturing an opinion that they may be luetic. Tuberculous pleural effusions are not uncommon in individuals with systemic lues and are prone to disappear without any type of treatment. This statement may seem trite, but we have all seen such cases exhibited and labeled luetic pleural effusions solely because the fluid absorbed while the individual was being treated for syphilis.

The well-recognized tendency of the exudative type of pulmonary tuberculosis to undergo complete resolution has caused large numbers of such cases to be diagnosed, treated and later reported as pulmonary syphilis, solely because the patient had a positive Wassermann reaction and the sputum was negative for tubercle bacilli.

FIG. 1. April 11, 1928. Pulmonary syphilis. Condition as shown at first examination.

FIG. 2. May 11, 1928. Same case as shown in Figure 1, three weeks after antiluetic treatment was instituted

The opportunity to recognize and follow through cases of pulmonary syphilis will be rare for roentgenologists except those who are associated with large free clinics or large hospitals for the treatment of lung diseases.

I have discovered in the literature one case of pulmonary syphilis which has been of great interest and aid to me. This case was reported by Ornsten.[3] The case was at first diagnosed clinically as tuberculosis complicated by pleural effusion. No roentgenograms were made at this time. Later, plates were made which showed the fluid persisting and the pulmonary consolidation spreading. The sputum was consistently negative for tubercle bacilli. The roentgenologist, however, noticed on the second plate, a generalized widening of the aorta which prompted him to report an aortitis. The patient, in the meanwhile, had been confined to bed in a sanatorium for the treatment of tuberculosis. A positive Wassermann reaction was then obtained; antiluetic treatment was instituted with a prompt disappearance of the pleural effusion and the pulmonary consolidation. This case fulfills every possible qualification for a definite diagnosis of pulmonary syphilis and is of aid to us in that the changing pathology is beautifully shown on the complete series of plates with which the article is illustrated. To add to this case, I have another so similar in appearance and behavior that the resemblance is striking.

CASE REPORT

The patient, a woman, unmarried, aged thirty-nine, consulted me on April 11, 1928, regarding the possibility of roentgen treatment helping a lung condition which she was supposed to have. She had been subject to slight attacks of pleurisy for several years and because of a family history of tuberculosis had great fear of contracting the disease. For this reason her chest had been roentgenographed many times over a period of years and she brought with her a complete album of chest films. She had been reassured that all of her plates were quite negative till November of last year. At that time she had contracted influenza during an epidemic and was confined to bed for ten days. The attack subsided promptly and her recovery was complete. A routine roentgenogram was made of her chest at that time to exclude the possibility of a pneumonia. No diagnosis was given the patient from this plate. Following this attack of influenza she continued to cough and began to experience a dull ache and lameness in her right chest. She lost no weight, had no fever and no expectoration

Late in March she consulted a physician

Fig. 3. August 11, 1928. Same case as shown in Figures 1 and 2. Roentgenogram taken fifteen weeks after antiluetic treatment was instituted.

in a nearby city who advised her to bring her plates and consult me regarding roentgen therapy for a condition which existed in her right lung. I obtained stereoscopic plates of her chest on April 11, and also roentgenoscoped the chest. This then gave me a series of plates extending back several years before her attack of influenza, plates made during the attack of influenza in November, 1927, and plates made on April 11, 1928.

The plates prior to November, 1927, were entirely negative. The plates made during the influenza attack showed a nodular consolidation extending out from the root of the right lung and invading the parenchyma of all three lobes. The shadow of the right diaphragm was faintly visualized through a thickened pleura which partially obscured the lower half of the chest. This consolidation was almost homogeneous in character and presented a sharp line of demarcation from the normal lung.

The plates made in my office on April 11, 1928, showed a definite extension both in the thickening of the pleura and in the pulmonary consolidation. The shadow of the right diaphragm was one interspace higher than normal

and showed a definite limitation of excursion when compared with the left. The heart was not displaced and the left lung showed no evidence of involvement (Fig. 1). Oblique roentgenoscopy showed no evidence of mediastinal involvement.

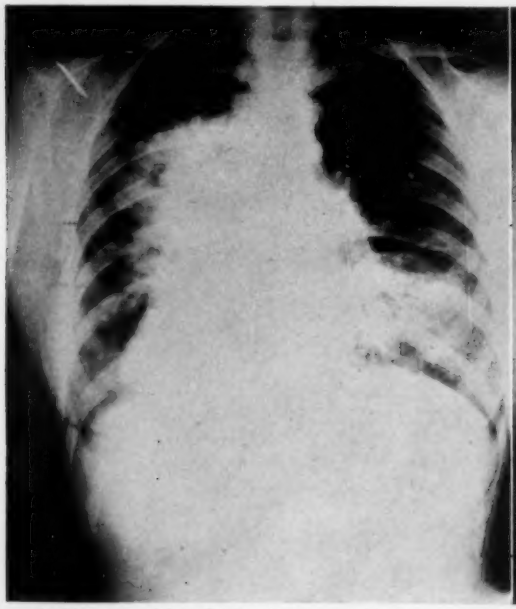

FIG. 4. Infiltrative Hodgkin's disease, left upper and right lower lobes. This case is presented to show the marked similarity of appearance between proved Hodgkin's disease and proved pulmonary syphilis.

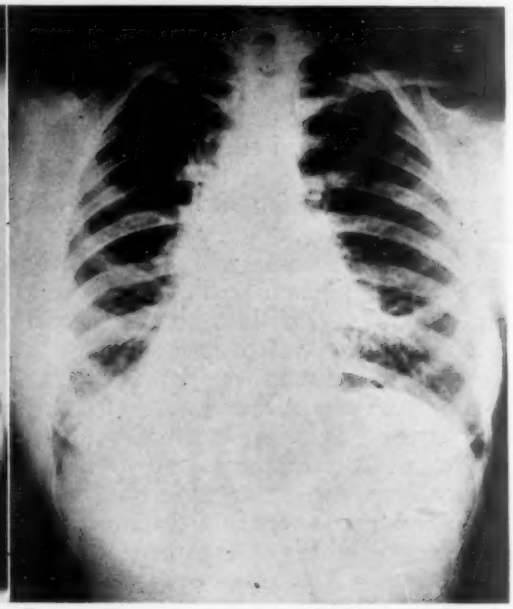

FIG. 5. Same case as shown in Figure 4. Result after one series of deep roentgen therapy.

The only physical examination which I made at this time was to ascertain that the cervical, axillary, epitrochlear and inguinal glands were not palpable. She was then referred to an internist with the report from the numerous plates and the following conclusion drawn from a study of them:

"I believe that we can rule definitely against tuberculosis, abscess, bronchiectasis, primary carcinoma of the bronchus and metastatic tumor. The lesion has shown a definite extension during the last five months. The lesion more nearly resembles an infiltrative type of Hodgkin's disease than any other condition I have encountered. In case you cannot reach a definite diagnosis, I would like to administer deep x-ray treatment with the idea of proving or disproving my opinion that this represents Hodgkin's disease."

She was sent back to me for identification of a questionable mass in the right lower quadrant of the abdomen. This mass remained elusive. Roentgen study of the gall-bladder, gastrointestinal and urinary tracts was negative. The physical examination was negative except for physical signs in her chest which closely approximated the roentgen findings. The blood Wassermann was positive. She was next referred to a bronchoscopist who reported, after bronchoscopy, that he could detect no evidence of carcinoma or other intrabronchial pathology.

It was then decided, on April 20, to place her on antiluetic therapy of salvarsan and mercury. On May 11, approximately three weeks after treatment was instituted, a second set of plates was made of her chest. These plates showed a most remarkable resolution of the process (Fig. 2). Treatment was continued. A third set of plates was made on August 11. These show an almost complete disappearance of the lesion (Fig. 3). The cough, as well as the aching and lameness in the chest, has entirely disappeared. These were the only symptoms from which she suffered.

I regret that it was impossible to obtain prints from the original plates showing a normal condition of the lungs and also the first plates showing the pathology.

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CHOLECYSTOGRAPHY*

ORAL ADMINISTRATION OF TETRAIODOPHENOLPHTHALEIN IN ONE HUNDRED CONSECUTIVE CASES, CHECKED AGAINST SURGICAL FINDINGS

BY C. J. JOHANNESSON, M.D.

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THE value of cholecystography as an aid in diagnosis of gall-bladder disease has been established during the past few years, and in this brief report I do not expect to add any new information to a subject which has been so thoroughly covered by workers of more experience. I shall only give briefly the roentgen findings obtained by a routine oral administration of tetraiodophenolphthalein combined with the barium meal for gastrointestinal study, compared with the operative findings.

This series of cases is, of course, too small to warrant any definite conclusion, but in view of the surgical findings in 100 consecutive cases, I am convinced of the value of a combination of cholecystography with the barium meal. The oral administration has proved very reliable except in approximately 2 per cent of the cases in which common duct stones were found at operation, and which had not been visualized on the roentgen films.

The majority of patients referred to us are ambulant, with indeterminate abdominal symptoms suggesting gall-bladder disease or some other right upper quadrant pathology. The patients are rarely hospitalized and can usually leave their regular occupations only long enough for the roentgen examination. We therefore sought to develop a technique of gall-bladder and gastrointestinal examination requiring the shortest possible time and still maintaining the greatest amount of accuracy.

In view of the fact that a great number of patients referred rarely come with definite symptoms of cholecystitis or much information as to any other symptoms, I am not able to state how frequently cholecystitis was the clinical diagnosis.

In the early Summer of 1925, when reports were published concerning oral administration of the dye in coated capsules, I employed this method but did not obtain satisfactory results. It was then thought by those using the oral method that the capsules should pass into the duodenum and there be dissolved and the dye absorbed. By accident in one case, the dye was mixed with cereal and the gall-bladder was visualized perfectly, the patient suffering no reaction. This procedure was then followed and proved more satisfactory, the patients being less nauseated and the gall-bladder shadow being visualized with greater uniformity. This method of administration has since been used up to the conclusion of this report. Since then (June 1, 1928) we have used the tetradol emulsion in grape juice, keeping the rest of our technique the same and have obtained equally good, if not better, visualization of the gall-bladder.*

A fixed technique has been adopted, varying only the penetration depending upon the patient's thickness; the milliamperage, time, target film distance, etc., remain the same. The Bucky diaphragm is used in every case.

The patient is instructed to eat the usual supper at six o'clock in the evening. Two hours later the contents of six capsules (5 grains each) of Kerasol are thoroughly mixed with four tablespoonfuls of cold cooked cereal. This mixture is sweetened with sugar, honey or syrup and then eaten. The patient should drink plenty of water during the remainder of the evening and report for roentgen examination the following morning, twelve hours after the ingestion of the dye. Breakfast is omitted.

Films of the gall-bladder are taken and inspected. A normally functioning gall-bladder is satisfactorily outlined at this time. The barium meal is then given.

* We have found that 4 ounces of grape juice is ample, followed by a glass of water, as too much grape juice has too great a laxative effect.

* Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

Roentgenoscopic study is made of the stomach and duodenum for the detection of possible organic lesions. The function

FIG. 1. Shows chronic inflamed gall-bladder, stone in common duct, barium meal regurgitated into common duct. Operation showed cholecystitis, with stone the size of a pigeon egg in the common duct.

FIG. 2. Shows abnormal thickening of gall-bladder; cholecystitis. No stones. Note that the "usual" crescent-shaped pressure on duodenal bulb is here due to inferior pole of the kidney. Cholecystectomy showed thick, tenacious bile present; no stones.

FIG. 3. Pathological gall-bladder. Cholecystectomy showed empyema of gall-bladder.

FIG. 4. "Strawberry" gall-bladder, suspicious of small calculi. At operation a "mulberry" gall-bladder was removed. Numerous small calculi were present.

of these structures is observed, any reflex spasm is noted, also position and relation of organs, as well as any possible indirect detailed study. At this time we have often noted intermittent regurgitation in the duodenal arch in cases of cholecystitis,

though this phenomenon has been observed in only 17 per cent of the cases in this series.

FIG. 5. Female, aged fifty-seven, had clinical symptoms of cholecystitis. Roentgen study with dye demonstrated normal gall-bladder, while barium meal revealed a heavy band of adhesions across the colon. After bands of omental adhesions were released surgically all symptoms of "cholecystitis" disappeared.

The patient is instructed to take no food and to return again five hours later. Films of the gall-bladder are again taken. The normal gall-bladder usually shows greater concentration than at the first examination, while a diseased gall-bladder maintains a faint unchanged shadow. A roentgenoscopic and roentgenographic study is made of the progress of the barium meal.

The patient is now instructed to eat a meal rich in fats at 2.30 in the afternoon and to return two hours later. At this time roentgenograms of a normal gall-bladder will show entire, or almost entire, disappearance of shadow, while a diseased gall-bladder will show little or no material change in size or density. Roentgenoscopic observations and films are made of the progress of the barium meal, which at this time is usually filling the coils of ileum, outlining ileocecal coil and cecum com-

FIG. 6. "Negative stones" completely filling fundus of gall-bladder.

FIG. 7. Roentgen examination showed chronic inflamed gall-bladder. No stones. Duodenum displaced by gall-bladder. Operation showed cholecystitis, gall-bladder much thickened; small stones in the common duct. (Failure of dye to visualize stones in common duct.)

TABULATION OF 100 CONSECUTIVE PATIENTS OPERATED UPON

Serial No.	X-Ray No.	Date	X-Ray Findings	Surgical Findings
1	6846	8/20/25	Large distended gall-bladder. 36 hrs. visible. No stones.	Strawberry gall-bladder. Removed. No stones present.
2	6870	8/28/25	Normal gall-bladder. Adhesions right lower quadrant, abdomen.	Gall-bladder normal on palpation. Post-operative appendicial adhesions. Salpingectomy.
3	7022	10/10/25	Faint visible gall-bladder, 36 hrs. Cholecystitis.	Chronic cholecystitis. No stones. Gall-bladder removed.
4	7056	10/21/25	Large diseased gall-bladder. 7 "negative" stones.	Cholecystitis. Gall-bladder removed; 7 medium-sized stones.
5	7075	10/27/25	Faint shadow of gall-bladder 12 hrs. Cholecystitis. Indirect signs.	Chronic cholecystitis. No stones. Gall-bladder removed.
6	7079	10/28/25	Large distended gall-bladder visible 36 hrs. No change after fat.	Empyema of gall-bladder. No stones. Hepatitis.
7	7259	12/26/25	Normal function gall-bladder. Pathological appendix with adhesions.	Gall-bladder normal. Appendectomy.
8	7620	1/13/26	Gall-bladder faintly visible 17 hrs. Indirect signs. No stones.	Chronic cholecystitis. Gall-bladder removed. No stones.
9	7648	1/29/26	Large gall-bladder; faintly visible at 36 hrs. Irregular outline. Several small calculi present.	Chronic cholecystitis. Extensive pericholecystic adhesions. Numerous small gallstones (operated on at Ellensburg, Wash.).
10	7653	2/1/26	Consistent faint visible gall-bladder shadow 36 hrs. No stones. Indirect signs.	Chronic cholecystitis. Thick, tenacious bile.
11	7673	2/10/26	No definite gall-bladder visible. Shadow in region of common duct indicative of stone.	Two large stones in common bile duct. Cholecystitis. (Clinical: intermittent jaundice.)
12	7694	2/18/26	Chronic diseased gall-bladder. No stones. Indirect signs. Gall-bladder visible only at 36 hrs.	Severe inflamed gall-bladder. Stricture of cystic duct. No stones present.
13	7706	2/26/26	Normal function gall-bladder except slow contraction. Duodenal ulcer.	Gall-bladder normal to palpation. Chronic duodenal ulcer.
14	7765	3/1/26	Very faint shadow at 12 hrs. Several small calculi present.	Old inflamed gall-bladder. Numerous small soft stones.
15	7767	3/2/26	Large, low pendulous gall-bladder visible after "fat-meal" and 36 hrs. No stones.	Hydrops of gall-bladder. No stones. (Operation at Spokane, Wash.)
16	7825	3/27/26	Gall-bladder visible 42 hrs. Cholecystitis. No stones.	Chronic cholecystitis. Gall-bladder removed. No stones.
17	7830	3/31/26	Faintly visible 12 and 17 hrs. Indirect signs. No stones.	Walls thick and fibrous. Adherent to liver. No stones.
18	7834	4/3/26	Enlarged gall-bladder; indirect signs. Visible 36 hrs. No stones.	Chronic cholecystitis. Removed. No stones. Chronic pancreatitis.
19	7874	4/20/26	No gall-bladder visible on 2 tests. Indirect signs. Adhesions duodenum and hepatic flexure. Carcinoma of stomach.	Gall-bladder distended, surrounded by dense adhesions. Ducts enlarged. Carcinoma of gall-bladder; adjacent glands and pyloric end stomach.
20	7910	5/5/26	Faintly visible 17 to 36 hrs. Irregular outline on visceral side. No stones.	Chronic cholecystitis. Adhesions to omentum. No stones.
21	7928	5/17/26	Gall-bladder visible 12 and 17 hrs. No contraction after "fat-meal." Absent 36 hrs. Path. appendix. (Right hernia.)	Gall-bladder not removed; emptying by manipulation. Appendectomy and herniotomy. (Operation in Tacoma, Wash.)
22	7944	5/21/26	Gall-bladder shadow at 42 hrs. Indirect signs. No stones.	Chronic cholecystitis. Extensive peri cholecystic adhesions.
23	7969	5/26/26	Faint shadow gall-bladder. Positive gallstones seen.	Numerous large gallstones. Gall-bladder removed.
24	7970	6/14/26	Gall-bladder shows normal function. Pathological appendix.	Normal gall-bladder. Chronic inflamed appendix; removed.
25	8022	6/22/26	Gall-bladder visible 36 hrs. No stones. Path. appendix. Omental adhesions.	Catarrhal condition of gall-bladder. Appendectomy. Adhesions released.
26	8053	7/9/26	Gall-bladder visible 12 and 17 hrs. only. Indirect signs. Small calculus in duct.	Walls of gall-bladder thick and fibrous. Small stone in cystic duct.
27	8065	7/10/26	Gall-bladder visible 17 to 36 hrs. One large and several small stones. Path. appendix.	Gall-bladder removed; one large hard stone; numerous small stones. Appendectomy.

TABULATION OF 100 CONSECUTIVE PATIENTS OPERATED UPON (*Continued*)

Serial No.	X-Ray No.	Date	X-Ray Findings	Surgical Findings
28	8095	7/29/26	Normal functioning gall-bladder located high up under liver. Chronic pathological appendix.	Normal gall-bladder. Appendectomy.
29	8096	7/30/26	Gall-bladder normal shadow; slow contraction after "fat-meal." No stones. Path. appendix.	Gall-bladder normal to palpation. Appendectomy.
30	12009	8/7/26	Gall-bladder decreased concentration; contracted after "fat-meal" and absent 36 hours. Path. appendix, extensive omental adhesions.	Indicative of catarrhal condition of gall-bladder; gall-bladder not removed. Appendectomy; adhesions and omentum released.
31	12034	8/19/26	No visualization of gall-bladder nor stones. All indirect findings.	Several stones in gall-bladder, which was large and distended; 4 stones in common bile duct.
32	12043	8/24/26	Normal functioning gall-bladder. Chronic pathological appendix.	Gall-bladder normal. Appendectomy.
33	12058	9/1/26	Gall-bladder only visible 12 hrs. Regurgitation of barium meal into common duct. Small stone in common duct.	Chronic cholecystitis. Stone, pigeon-egg size, in common bile duct.
34	12115	9/28/26	Gall-bladder visible 36 hrs. No stones. Path. appendix.	Chronic cholecystitis. Appendectomy.
35	12152	10/16/26	Gall-bladder normal function. Retrocecal appendix.	Gall-bladder normal. Appendectomy (retrocecal appendix). Jackson's membrane present.
36	12170	10/24/26	Gall-bladder faintly visible 12 hrs.; almost absent 17 hrs. No indirect signs. Adhesions of coils of ileum.	Gall-bladder not explored. Complete hysterectomy; bowel adherent in pelvis. (Caesarian at previous date.)
37	12180	10/28/26	Gall-bladder visible 17 hrs. after "fat-meal" and 36 hours. Adhesions right lower abdominal quadrant.	Chronic cholecystitis. No stones. Omental adhesions to bowel and old abdominal scar, right side.
38	12213	11/11/26	Large, pear-shaped gall-bladder visible 36 hrs. No stones. Indirect signs.	Large, thick inflamed gall-bladder. No stones. Gall-bladder removed.
39	12237	12/9/26	Faintly visible gall-bladder; no contraction after "fat-meal." Absent 36 hrs. Path. appendix.	Catarrhal gall-bladder removed. Appendectomy.
40	12252	12/9/26	Gall-bladder visible 36 hrs.; several minute stones.	Chronic cholecystitis. Numerous small stones. Dilatation of common bile duct.
41	12254	12/13/26	Gall-bladder small and contracted; absent 36 hrs. Right lower abdominal quadrant pathology.	Gall-bladder unusually small; normal. Chronic inflamed appendix bound in mass of adhesions.
42	12261	12/20/26	Gall-bladder visible 42 hrs. Indirect signs. Kinked path. appendix. Omental adhesions.	Chronic cholecystitis. Removed. Appendectomy. Omentum released. (Operation in Portland, Oregon.)
43	12270	12/23/26	Normal functioning gall-bladder. Chronic inflamed appendix.	Gall-bladder free and normal. Appendectomy.
44	12274	12/24/26	Normal functioning gall-bladder. Right lower abdominal pathology.	Gall-bladder normal. Appendectomy; right salpingectomy.
45	12324	1/15/27	Gall-bladder enlarged, pendulous; omental adhesions; visible 36 hrs. Postoperative adhesions to old abdominal scar.	Numerous omental and small bowel adhesions to anterior abdominal wall. No stones in gall-bladder; but gall-bladder thick and inflamed.
46	12401	2/17/27	Gall-bladder slow contraction; absent 36 hrs. Path. appendix.	Gall-bladder normal. Retrocecal appendix. Omental adhesions.
47	12421	2/24/27	Gall-bladder visible only 12 hrs. Indirect signs. Regurgitation of barium meal into common duct.	Chronic cholecystitis. Large, thick common bile duct. No stones.
48	12448	3/5/27	Normal functioning in gall-bladder. Chronic ulcer of pars media, stomach.	Gall-bladder normal. Large ulcer of stomach. Gastrojejunostomy.
49	12460	3/10/27	Normal functioning gall-bladder. Pelvic pathology.	Gall-bladder normal. Hysterectomy. (Operation, Seattle, Wash.)
50	12492	3/23/27	Gall-bladder visible 36 hrs.; no stones. Indirect signs. Appendix absent.	Enlarged thickened gall-bladder. Local cirrhosis.
51	12528	4/5/27	Normal functioning gall-bladder; irregular along visceral side. Chronic inflammatory appendix.	Gall-bladder normal to palpation. Fine omental adhesions to one wall. Appendectomy.
52	12548	4/13/27	Gall-bladder visible at 17 hrs. only. Small "negative" stones on one film only. Indirect signs.	Chronic cholecystitis. Small stone in neck of gall-bladder, adherent to wall.

TABULATION OF 100 CONSECUTIVE PATIENTS OPERATED UPON (*Continued*)

Serial No.	X-Ray No.	Date	X-Ray Findings	Surgical Findings
53	12547	4/14/27	Gall-bladder visible 42 hrs.; fixation of duodenal arch. No stones.	Enlarged thickened gall-bladder. Adhesions to duodenum. No stones.
54	8241	(Hospital): 4/26/27	Normal functioning gall-bladder. Chronic pathological appendix.	Gall-bladder empty normal on palpation. No stones. Appendectomy.
55	8242	(Hospital): 4/26/27	Normal function of gall-bladder. Coils of ileum adherent in right side. Appendix absent.	Gall-bladder normal. Omentum and small bowel (ileum) adherent to old abdominal scar. Right herniotomy.
56	12577	4/28/27	Gall-bladder very long and pendulous. Long pedicle. No stones.	Long and tortuous pedicle; adhesions. Gall-bladder removed. No stones.
57	12587	5/2/27	Gall-bladder visible 36 hrs. Two small shadows outside suggestive of calculi in common duct (?).	Chronic cholecystitis. Two stones; one large, one small in common duct. Gall-bladder adhesions to duodenum.
58	12590	5/3/27	Large, low, very dense gall-bladder shadow 36 hrs. Indirect signs. Intermittent duodenal regurgitation.	Large empyema of gall-bladder. No stones.
59	12591	5/4/27	Gall-bladder visible 12 hrs.; faint shadow 17 hrs. Indirect signs.	Gall-bladder strawberry type removed. Adhesions. No stones.
60	12607	5/12/27	Gall-bladder visible 42 hrs. Large shadow; indirect symptoms. No stones.	Gall-bladder distended, filled with thickened secretion; about 4 times normal size; few adhesions along wall.
61	12617	5/17/27	Gall-bladder normal function. Chronic pathological appendix.	Normal gall-bladder. Appendectomy.
62	12618	5/18/27	Gall-bladder visible 12 hrs.; then absent. Indirect signs. Path. appendix; adherent.	Gall-bladder wall thickened; bile had the appearance of being mixed with mucus. Gall-bladder removed. Appendectomy.
63	12623	5/19/27	Gall-bladder visible 36 hrs. No stones. Concretions in appendix.	Chronic cholecystitis. No stones. Appendix distended with numerous concretions.
64	12641	5/24/27	Large distended gall-bladder shadow; faintly visible 36 hrs.; 2 small "negative" stones.	Simulating large strawberry-type gall-bladder; 3 small stones; several small minute calculi.
65	12640	5/25/27	Gall-bladder visible 12 and 17 hrs.; indirect symptoms. Extensive adhesions, right lower side; constriction of ileocecal coil. Path. appendix.	Thickened fibrous gall-bladder. Appendectomy; ileocecal coil freed; adhesions released. Gall-bladder not removed at this time; (removed Dec., 1927).
66	12642	5/25/27	Gall-bladder visible faintly at 36 hrs.; indirect signs.	Chronic gall-bladder infection. Adhesions. Removed.
67	12652	6/1/27	Gall-bladder faintly visible 36 hrs.; no indirect signs. Right pelvic pathology.	Indicative of catarrhal condition of gall-bladder. Not removed. Large ovarian cyst (right).
68	12661	6/4/27	Gall-bladder normal function. Diseased appendix; adherent.	Normal gall-bladder. Appendectomy. Adhesions.
69	12676	6/10/27	Gall-bladder visible 17 to 36 hrs. No stones. Some indirect signs.	Chronic gall-bladder infection. Gall-bladder removed.
70	12745	7/9/27	Gall-bladder shows normal function. Transverse colon pulled down by omental adhesions and fixed. Path. appendix.	Normal gall-bladder. Old pelvic adhesions and omental adhesions. Appendectomy.
71	12746	7/9/27	Enlarged gall-bladder visible 36 hrs.; no stones. Indirect signs.	Mulberry gall-bladder removed. No free stones in gall-bladder.
72	12758	7/15/28	Normal function of gall-bladder. Long, tortuous appendix with concretions.	Gall-bladder normal. Appendectomy.
73	12760	7/16/27	Normal gall-bladder function. Path. appendix; ileum pulled across cecum and adherent.	Gall-bladder normal. Appendectomy. Coil of ileum freed; omentum released.
74	12793	7/27/27	Gall-bladder fundus visible only at 12 and 17 hrs.; faint shadow. No stones. Adhesions. (Gall-bladder had previously been drained at operation.)	Gall-bladder removed; no stones. Extensive omental and intestinal adhesions involving entire right upper quadrant, including small end of stomach.
75	12847	8/31/27	Faint persistent gall-bladder shadow 36 hrs. Indirect signs. Chronic pathological appendix.	Chronic cholecystitis. No stones. Appendectomy.
76	12863	9/1/27	Gall-bladder shadow persists 36 hrs.; no contraction after "fat-meal." Appendix absent.	Strawberry gall-bladder removed. No free stones. Postoperative appendicial adhesions.

TABULATION OF 100 CONSECUTIVE PATIENTS OPERATED UPON (*Continued*)

Serial No.	X-Ray No.	Date	X-Ray Findings	Surgical Findings
77	12866	9/3/27	Enlarged faint shadow at 12 hrs.; indirect signs. (Clinical: cholecystitis.)	Enlarged and thickened gall-bladder. Thick tenacious bile. No stones.
78	12875	9/8/27	Normal functioning gall-bladder. Heavy band of omental adhesions across transverse colon.	Gall-bladder normal. Dense heavy band about center of transverse colon from omentum. No malignancy present.
79	12934	10/1/27	Faint persistent gall-bladder shadow 36 hrs. No stones. Irregular contour outline.	Thickened adherent diseased gall-bladder; 2 small stones in common bile duct.
80	12939	10/4/27	Several "negative" gall-bladder stones. Gall-bladder visible only at 36 hrs. Indirect signs.	Numerous small gallstones in gall-bladder. Gall-bladder chronic inflammatory changes.
81	12942	10/5/27	Large gall-bladder shadow 36 hrs. No stones. Chronic diseased appendix.	Chronic inflammatory changes simulating strawberry type. No stones. Appendectomy.
82	14015	11/8/27	Normal functioning gall-bladder. Carcinoma, pars media of stomach.	Gall-bladder apparently normal to palpation. Inoperable carcinoma of stomach.
83	14056	11/23/27	Gall-bladder visible 12 hrs. only. Chronic pathological appendix bound down by adhesions.	Indication of slight thickening of gall-bladder; emptied by palpation. Not removed. Appendectomy.
84	14102	12/14/27	Normal function gall-bladder. Chronic duodenal ulcer.	Gall-bladder normal. Duodenal ulcer just beyond pyloric sphincter.
85	14151	1/5/28	Gall-bladder faintly visible 36 hrs.; no change after fat-meal. No stones. Indirect signs.	Chronic cholecystitis.
86	14155	1/6/28	Gall-bladder shadow persists 42 hrs.	Enlarged thick, inflamed gall-bladder;
87	14172	1/13/28	Gall-bladder visible 12 hrs. only; 3 stones persist.	3 stones in gall-bladder, 1 in cystic duct; gall-bladder removed.
88	14182	1/19/28	Large distended gall-bladder shadow persists 36 hrs. Indirect signs. Small stones present.	Greatly distended, inflamed gall-bladder. Extensive adhesions. Numerous small stones in gall-bladder.
89	14191	1/23/28	Low pendulous gall-bladder with long pedicle. Indirect signs.	Chronic cholecystitis; tortuous pedicle. No stones.
90	14284	2/8/28	Gall-bladder visible 36 hrs.; no indirect signs. No stones. Pelvic pathology.	Chronic thickened gall-bladder; catarrhal type. Gall-bladder removed. Cystic ovaries and ligament cysts.
91	14323	2/22/28	Gall-bladder visible 36 hrs. Indirect signs. Adhesions.	Gall-bladder enlarged and thickened; adherent. Chronic hepatitis.
92	14332	2/28/28	Gall-bladder visible 12 hrs. only. No stones. Indirect signs.	Distended yellow gall-bladder; unusually thin walls. No stones.
93	14347	3/5/28	Pendulous gall-bladder, long pedicle. No change after "fat-meal."	Adhesions from omentum. Cholecystitis. Gall-bladder removed.
94	14412	3/31/28	Gall-bladder not visible with dye; no visualization on re-check. Indirect signs. Shadows suggest stones (?).	Cholecystitis; 3 stones in gall-bladder; 7 large stones in common duct; duct dilated to size of bowel.
95	14438	4/11/28	Faintly visible gall-bladder 36 hrs. No stones.	Cholecystitis. Extensive omental adhesions. Small stone in cystic duct.
96	14444	4/14/28	Gall-bladder visible 36 hrs. Indirect signs. Duodenal stasis.	Chronic cholecystitis; 4 very small stones.
97	14465	4/25/28	Golf-club deformed gall-bladder. Adhesions. No stones. Small stone in left kidney.	Extensive omental adhesions to gall-bladder. Old inflammatory changes. No stones.
98	14469	4/27/28	Gall-bladder shadow visible 36 hrs. Indirect signs.	Enlarged thick gall-bladder removed. No stones.
99	14479	4/30/28	Gall-bladder visible 36 hrs.; no change after fat-meal. Indirect signs. No stones.	Chronic cholecystitis. Gall-bladder removed. No stones.
100	12089	9/10/26	Large "mottled" gall-bladder shadow persists 36 hrs. Small stones present.	Strawberry gall-bladder removed. Numerous minute calculi present.

pletely, giving opportunity to note any adhesions or abnormalities in the right lower quadrant and about the appendix, as well as possible fixation of hepatic flexure and omental or pericholecystic adhesions.

The regular evening meal is then eaten and further studies of the barium meal made the following morning, when a normal gall-bladder is no longer visible, but a diseased gall-bladder may persist, though usually as a very faint shadow. The colon at this time is entirely outlined

with the barium meal and is studied for abnormalities or organic lesions. Occasionally the stomach and duodenum are reëxamined at this time with a second barium meal, especially if some undetermined condition has been observed the day before.

Of course criticism may be made that the barium meal can obscure the gall-bladder shadow or common duct stones, as shown in Figure 4, but by a series of films we have been able to overcome this disadvantage.

This procedure is followed exactly in all cases. Since a fixed technique is used our interpretations have followed more or less standardized criteria. While our methods and results may not compare with those in institutions or where time is not an important factor, they have proved satisfactory from our standpoint.

Complete absence of gall-bladder shadow should always be looked upon as failure of technique until proved otherwise.*

Our experience has also proved that indirect signs are very valuable in connection with cholecystography and stimulate a more careful and thorough search for pathology, either in the gall-bladder or digestive tract, and we therefore should not yet dispense with the barium meal in gall-bladder study.

ABSTRACT OF DISCUSSION

DR. B. R. KIRKLIN, Rochester, Minn. In my limited experience with cholecystography I have formed some rather firm convictions as to interpretation of the cholecystogram. One of these convictions, and to me the most important one, is that the principal thing we have to determine in evaluating a cholecystogram is whether or not the gall-bladder has the ability to concentrate the dye. Of course, the demonstration of stone shadows is a direct evidence of their presence.

It is our rule that if we obtain a shadow of the gall-bladder at any period—I don't mean the shadows that are published as normal shadows but practically any shadow—this is interpreted as a normally functioning gall-bladder.

It is rather interesting that early in our work we paid a great deal of attention to the so-called faint shadow and assumed that it indicated an abnormal or poorly functioning gall-bladder. In reviewing our work of the first year or two with cholecystography, we found that our percentage average, or accuracy, in this particular group was slightly more than 80 per cent. In 80 per cent of the ones that we interpreted as faint shadows of poorly functioning gall-bladders, only 80 per cent were confirmed at the surgical table. Since we have become more conservative in evaluating the faint shadow, in the last year's work the percentage of accuracy of poorly functioning gall-bladders, or faint shadows, went to 94 per cent. In other words, it is very unusual for us at the Mayo Clinic to make a diagnosis of cholecystic disease on a faint shadow.

I agree that the best shadows are usually obtained at the sixteen-hour period. We have had a little different experience, however, with our gastroenterostomy cases than have others. Some of you will recall that at New Orleans I showed a series of cases, discussing the normal cholecystogram in which some of the very best shadows that we obtained had been in those cases in which there was a gastroenterostomy.

We thought at first there was a possibility of a duodenal ulcer, and in one paper which I presented at the Boston State Medical Society meeting I called attention to the fact that it was rather interesting, but did not draw any conclusions, however, that in a high percentage of the cases in which there was a duodenal ulcer present and a normal gall-bladder at operation, we had not obtained a normal cholecystographic response.

However, on reviewing a larger series of cases we found that we got just as good gall-bladder shadows in the presence of a duodenal ulcer as in other conditions.

The unfortunate situation with cholecystography is that our highest percentage of errors, at least in my experience, occur in that group giving a normal response, or a response that we interpret as normal.

The oral versus the intravenous method was mentioned. With an idea of learning whether or not the intravenous administration of dyes has any merit over the oral administration, we checked a fairly large series of cases in which we had obtained no shadow of the gall-bladder with the intravenous administration of the dyes, and I think I can safely say that in no

* A recent experience at one of our hospitals proves this statement. The six capsules with full instructions were left with the nurse. The patient reported the following morning and the roentgen examinations were made during the day. The duodenal cap showed an ulcer present but at no time was the gall-bladder shadow visualized. The patient stated he had the cereal and "medicine" the night before. Upon investigation it was found that the nurse still had five capsules in her desk. On reexamination with the regular amount of tetraiodophenolphthalein we found a normally functioning gall-bladder. Operation showed a duodenal ulcer and normal gall-bladder, with adhesions to visceral side of gall-bladder.

cases where we were sure that we had good technical films were we able to demonstrate a gall-bladder shadow that had not previously been shown with the oral method. I don't mean there were no cases, but there were a few cases in which we obtained a shadow, and in which upon reviewing the films made with the oral administration we found we should not have attempted to make a diagnosis, as there was either movement or gas, or the films were of very poor quality. I feel very strongly that the oral method is very reliable. It should be 95 per cent reliable in positive cases, and in order to convince myself that our figures compared favorably I reviewed the same group of cases that had been reported by some intravenous enthusiasts, and we found that our percentage accuracy in this particular group, all examined following the oral method—that is, the group in which we had positive cholecystographic data and the gall-bladder was removed at operation—was high, for in only 9 cases of this group did the pathologist label the gall-bladder cholecystitis. That means he was only able to find microscopic evidence of disease in the gall-bladder.

For the sake of accurate statistics we counted these 9 cases as errors, as normal gall-bladders, which made our percentage accuracy 98.2 per cent in that particular group.

One should not misunderstand those figures as meaning that cholecystography in our experience is 98 per cent accurate, because it is not; that is, in all cases.

I am inclined to feel that if the cholecystographic examination is done simultaneously with the gastrointestinal examination small stones may be overlooked due to small particles of barium, or to being hid behind some of the barium meal.

At the present time at the Mayo Clinic we are administering the dye in an ounce of distilled water mixing it up fresh every day, and advising the patient to add this to a glass of grape juice. By this method we obtain better shadows, less reaction, and see less of the dye in the bowel. If we do see it in the bowel it is more of a homogeneous shadow instead of the lumpy shadows that we formerly saw in using the capsules.

I do not feel that we can depend upon deformities of the gall-bladder shadow as meaning pericholecystic pathology, adhesions, unless as in the exceptional case the deformity is constant and the gall-bladder lies in the same relative position throughout the examination. In our experience we have had a few of them, but they have been rather rare and we have seen any number of cases with deformity of the gall-bladder come to operation and find a perfectly free gall-bladder.

On the other hand, we have seen numbers of cases in which there was a perfectly normal contour of the gall-bladder shadow and found it buried in adhesions at the operating table. So that the only thing, with the exception of the presence of gallstones, that I think has very much significance is whether or not the gall-bladder has the ability to receive the dye and concentrate it.

RUGAE GASTRICAE

THEIR IMPORTANCE IN ROENTGENOLOGIC DIAGNOSIS

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THE average roentgenologic report, especially from a general roentgen-ray laboratory, usually describes the gastric findings in a more or less routine fashion. Mention is generally made of the morphology and position of the stomach and its peristaltic movements, but there is seldom any reference to the gastric rugae. Yet the rugae of the stomach can be easily visualized roentgenologically and their characteristics are of definite value in gastroenterologic diagnosis. I have paid special attention to this phase of roentgenography, as a result of which I am convinced that careful study of the gastric rugae frequently aids in establishing a gastroenterologic diagnosis that might otherwise be overlooked.

POINTS IN ANATOMY

The mucous membrane of the stomach, it will be recalled, presents many plaits or folds, which are called *rugae*. When the stomach is empty, these folds are very

pronounced, but when it is distended, the rugae are more or less effaced.

The rugae are arranged mostly in longitudinal folds, closely paralleling both the greater and lesser curvatures of the stomach. In the region of the fundus, however, they are stellate or irregularly transverse in direction. As the gastric mucosa is thicker at the pylorus than elsewhere, the rugae are much more conspicuous here than at the cardiac extremity of the stomach. During the state of contraction, when the stomach is not overfilled, the large longitudinal rugae are plainly visible on roentgenologic examination. Besides the rugae themselves, we must consider the numerous small elevations of mucous membrane known as "gastric areas," which vary greatly in shape and are partly separated from each other by furrows.

LITERATURE

"With the modern day instruments and the methods described," writes Rehfuss,[7] "it is entirely feasible to demonstrate the rugae in many instances by palpatory manipulation under the screen."

Rendich[6] in 1913 made important observations of the gastric rugae on the roentgenoscopic screen and roentgenograms: usually these folds arise in the cardia and extend downward towards the pylorus, parallel to the axis of the stomach. Frequently those near the greater curvature are oblique and may cross from the posterior to the anterior wall. Near the greater curvature, also, there may be a fragmentation of the rugae with a division into portions an inch or more in length that may be tortuous. The rugae may be equally well formed on the anterior and posterior walls, but frequently those on the anterior wall are not nearly so well marked. A wide variation in the arrangement of these mucosal folds may be noted in different individuals.

In the hypotonic type of stomach, Rendich found, there may be fewer in the vertical than in the horizontal arm; in the hypertonic type, the number is decreased from the cardia to the pylorus. In hypertrophic gastritis the rugae are enlarged, of somewhat irregular formation, and tend to resist obliteration. In atrophic gastritis there is absence of rugae formation. In carcinoma the rugae are often absent due to atrophic changes in the mucosa. While the rugae may be of normal formation in gastric ulcer, if there is formation of cicatricial tissue the rugae appear as radiating in all directions from the ulcer. If gastric ulcer is accompanied by hypertrophic gastritis, the rugae are increased in size.

For the demonstration of the rugae Rendich employs bismuth subcarbonate in mucilage of acacia as an opaque medium. Examination is first made with the roentgenoscopic screen; roentgenograms are made after the rugae are well delineated. He believes that stereoscopic plates are of value.

Forssell[4] in 1923 stated that the folds of the mucous membrane of the stomach are generally supposed to be caused by a passive folding-in, as a consequence of the contraction of the muscular coat (muscularis propria). But he is convinced from his study of both anatomic preparations and roentgenograms that the folds of the mucous membrane are formed by its own active movements. Movements of the mucous membrane in the upper part of the stomach were first demonstrated on the roentgenoscopic screen; later Forssell was able to show a visible movement of the folds of the mucous membrane in a series of roentgenograms.

In two roentgenograms of a normal stomach taken at an interval of one minute in an unchanged prone position, Forssell found that in the upper half of the curvatura major, where the mucous membrane showed deep folds, the folds changed their number as well as position and form without a visible change in the width of the stomach at this point. Another series of four roentgenograms of a stomach taken in the supine position at intervals of half a minute showed that the folds of the mucous membrane had changed their form and width in this short time.

Forssell points out that, when the muscular coat is distended, no folds may appear on the mucous membrane. A certain degree of contraction of the muscular coat with corresponding diminution of the

cavity of the stomach, therefore, seems to be necessary for the formation of the folds of the mucous membrane. However, folds on the mucous membrane appear with a moderate contraction of the muscular coat. During the later period of digestion, and especially with the subject in a recumbent position, the lower part of the stomach contracts with the appearance of numerous folds in the mucous membrane.

For roentgenologic study of the stomach, Baastrup[1] gives first half a tablespoonful of barium sulphate stirred up with water to a smooth, rather thick emulsion; then shortly afterward about 7 oz. of a smooth rice-flour porridge of rather thick consistency, flavored with cinnamon or sugar but without any thin liquid. With this meal he is able to demonstrate clearly the folds of the mucous membrane of the stomach. He has found that, as a rule, the direction of the folds of the mucous membrane is longitudinal when the roentgenogram is made with the patient in the upright position, although they may be somewhat irregular. In three of his cases the folds showed a radiating formation. In one case this was due to a cicatrix resulting from an operation; in two cases, to cicatrization of an ulcer.

Lysholm[6] in 1927 showed that by using a smaller amount of opaque substance and eventually superimposing it with air and then placing the patient in different positions a perfect idea of the inner surface of the stomach can be obtained. For the purpose of bringing out the mucous membrane or pathological changes on the anterior and posterior walls of the digestive tract when filled with opaque substance, he described a simple method of obtaining plastic pictures. The aim of this method was to obtain a cast of the inner surface of the stomach on the roentgen plate with the same definition as the impress on a coin. He used a diaphragm of Åkerlund's design especially constructed for rotation at high speed so as to avoid any undue lines on the pictures. The films were taken either in the supine or prone position.

Bauermeister[2] in 1927 observed in his roentgenograms that the mucous membrane folds descend from the upper part of the fundus in a longitudinal course, bend over in the region of the cardia, and there roll up until they are spiral-shaped, and that one or even two longitudinal folds run along the greater curvature. He also noted that the sulcus salivalis of Retzius is very clearly photographed as a longitudinal fold descending the whole length of the lesser curvature and reaching the mouth of the duodenum.

DEMONSTRATION OF GASTRIC RUGAE

The barium contrast meal, I have found, offers a simple means of determining the presence or absence of the gastric rugae, outlining their contour and evaluating their importance in reference to gastric disorders. Three methods may be employed to visualize them either roentgenoscopically or roentgenographically:

1. *Emptying the Stomach Partially of the Contrast Meal.* Because the rugae are effaced when the stomach is filled to capacity, part of the barium meal is removed preparatory to their study. By this maneuver the rugae of the cardiac segment may be visualized.

2. *Retaining the Barium in Thin Suspension.* With a thin suspension of barium, sedimentation takes place earlier and there is less of a tendency for the shadows of adjacent rugae to coalesce. By this means the observer is enabled to visualize the individual rugae.

3. *Displacing the Barium Meal by Pressure over the Midspine.* This maneuver brings the rugae of the median and prepyloric segments of the stomach into clear view. The pressure removes the excess of barium from this part of the stomach, thereby avoiding effacement of the rugae.

INTERPRETATION OF RUGAL ABNORMALITIES

Roentgenograms demonstrating an abnormal course of the gastric rugae or their permanent effacement in spite of partial emptying of the stomach may be of considerable diagnostic value. Lenk and Eisler[5] in 1921 showed that the rugae of the mucous membrane in the immediate vicinity of an ulcer do not run parallel but converge from the seat of the ulcer. Carman[3] in 1922 pointed out

that a change in the direction of the rugae at or near the ulceration may be demonstrated by the use of a watery solution of bismuth, which clearly shows the rugae of the stomach.

Distortion or localized effacement of the gastric rugae usually bespeaks induration or infiltration of the mucosa. This sign is especially important when it is associated with a localized absence of peristalsis. In the cardiac region of the stomach, distortion of the rugae coupled with deformity of the gas bubble practically clinches the diagnosis in favor of an organic lesion.

In studying the cardiac region of the stomach, it is particularly important to have the stomach practically empty. Otherwise, it may be inundated with the contrast medium, when the patient is in the prone position, with the result that the gas bubble is distorted and the rugae are effaced.

CONCLUSIONS

1. The study of the gastric rugae is a much neglected field, yet it may assist materially in gastroenterologic diagnosis.

2. Three methods may be employed to demonstrate the rugae roentgenologically: (1) emptying the stomach partially of the contrast meal; (2) retaining the barium in thin suspension, and (3) displacing the barium meal by pressure over the midspine.

3. Distortion or localized effacement of the gastric rugae usually indicates infiltration or induration of the mucosa.

4. The number, size, direction and configuration of the rugae should be described in complete roentgenologic reports of gastrointestinal examinations.

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A ROENTGEN STUDY OF LESIONS OF THE STOMACH AND DUODENUM, WITH AN ANALYSIS OF ERRORS IN DIAGNOSIS

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THE following report is based on a study of the case records of 888 patients referred to the X-ray Department of the Lexington Clinic for examination of the stomach and duodenum during the years 1926 and 1927. Especial attention is given to the records of those patients who were operated upon.

The technique of examination was not unusual, and has been described by a number of writers. Whenever possible the patients were given a barium-carbohydrate meal six hours before the examination. In many of our patients this was omitted, usually to permit a gastric analysis preceding the roentgenologic study. The immediate examination was done in the usual way. The majority of the patients were roentgenoscoped in both the vertical and horizontal positions. The latter was sometimes omitted, especially in slender patients, when roentgenoscopy in the standing position was satisfactory. Films were made following the roentgenoscopic

examination almost as a routine, but they were omitted occasionally when the screen study was entirely satisfactory and showed nothing abnormal.

The following statistics are limited almost entirely to the records of those patients who came to operation, and in which there was an operative note of exploration of the stomach and duodenum. These numbered exactly 100 patients, the majority of whom were operated upon by the surgical staff of the Lexington Clinic. Laparotomies were done upon a number of others, but for various reasons the stomach and duodenum were not explored. These cases are excluded, because the roentgen findings, which were negative, could not be considered as confirmed by operation.

FIG. 1. Duodenal ulcer; niche type of visible crater.

FIG. 2. Duodenal ulcer; fleck type of visible crater.

NEGATIVE ROENTGEN FINDINGS

In 49 of the 100 cases, the roentgen diagnosis was negative. Forty-seven of these proved to be correct, and 2 were definite errors. In each of the two which were diagnosed incorrectly a duodenal ulcer was found at operation.

CARCINOMA OF THE STOMACH

Nine patients came to operation with a diagnosis of carcinoma of the stomach. The diagnosis of malignancy was correct in all of the 9 cases, but determination of operability was less successful. Seven of the lesions were reported as being "operable" or "possibly operable." Three of these were resected. Three were frankly inoperable. The one remaining lesion was locally operable but there were extensive metastases to the lymph nodes. Two patients were explored in spite of a diagnosis of inoperable carcinoma, chiefly in the hope of doing a palliative operation. A resection was attempted in one case, but not all of the tumor could be removed. In the other case an exploration only was done.

The determination of operability as part of the roentgen examination was not satisfactory in this small series of cases, probably due to the inexperience of the examiner. However, when there seemed to be any possibility of a resection, the lesions were reported as probably or possibly operable, rather than deny patients the small chance that surgery might offer. It was considered preferable to err in this way.

Nine of the 10 patients who were not operated upon presented gastric tumors which were unquestionably inoperable. The tenth patient was operated upon elsewhere, and the surgical findings could not be obtained.

GASTRIC ULCER

There were 10 cases in which a diagnosis of gastric ulcer was made. In all of these

the diagnosis was essentially correct. Six were single gastric ulcers, one a double gastric ulcer, and one a gastric and a duodenal ulcer. These were confirmed exactly as diagnosed, by surgical exploration. In the remaining 2 cases, the roentgen findings were only partially correct. One of these was reported as a double gastric and probably a duodenal ulcer. At operation a single gastric ulcer was found, and the duodenum was normal. The other was reported as a double gastric ulcer. At operation, multiple gastric ulcers and a duodenal ulcer were found, the latter lession having been missed.

FIG. 3. Gastric ulcer and pseudo-gastric ulcer. The lower niche represents the true ulcer.

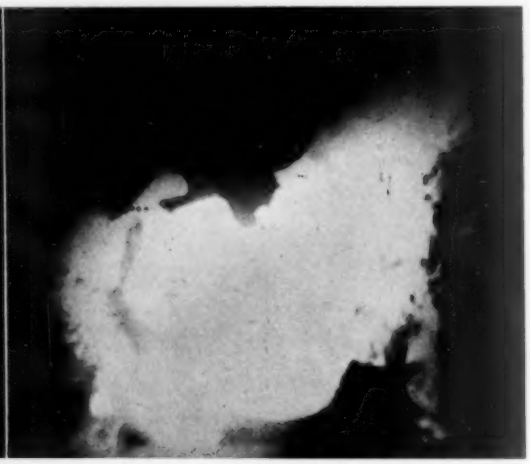

FIG. 4. Multiple gastric ulcers and a duodenal ulcer.

DUODENAL ULCER

A diagnosis of duodenal ulcer was made in 27 cases. An additional case so diagnosed is included with the gastric ulcer group. There was one error among the 27 cases. At operation the patient was found to have a cholecystitis, with adhesions between the gall-bladder and the first portion of the duodenum. The remaining 26 cases proved to be correctly diagnosed. In one of these, the roentgenoscopic examination revealed two niches in the first portion of the duodenum, and a diagnosis of multiple duodenal ulcers was made. At operation, two ulcers were found. A single ulcer crater was seen in 5 cases, with operative confirmation of the roentgen findings.

In the entire series of 888 cases, a diagnosis of duodenal ulcer was made 123 times. In 28 of these an ulcer crater was demonstrated. A few were seen as niches projecting outward along the outline of the duodenal bulb (Fig. 1), but this type of deformity was considered unreliable. Frequently multiple niche-like projections may be seen, no one of which is due to an ulcer crater. The majority were demonstrated by palpation of the duodenum, the crater showing as a dark "fleck" within the outline of the bulb when pressure was applied over it (Fig. 2). In 2 cases, palpation revealed a fleck, without visible deformity of the outline of the first portion of the duodenum. A diagnosis of ulcer was made but unfortunately neither of these patients was operated upon.

LESION AT THE OUTLET

In 4 of the 100 operated cases, a diagnosis of "lesion at the outlet" was made. The patients all showed, during the roentgen examination, a deformity at the pyloric end of the stomach, the cause of which could not be determined. An error in diagnosis was proved in one case, operation revealing a definite cholecystitis with no evidence of a lesion in the stomach or duodenum. The second patient was found to have a small carcinoma at the outlet. The 2 remaining cases were found to have duodenal ulcers.

EXAMINATION AFTER GASTROENTEROSTOMY

Only one patient, who was examined

after having had a gastroenterostomy, was later explored. The roentgen examination revealed a deformed duodenal bulb, and a normal gastroenterostomy functioning freely, with no deformity of the stomach or small bowel near the stoma.

One of the patients who was found to have a duodenal ulcer showed a markedly dilated stomach, with retention of food and secretion, and practically complete obstruction at the pylorus. The retained gastric contents made the examination

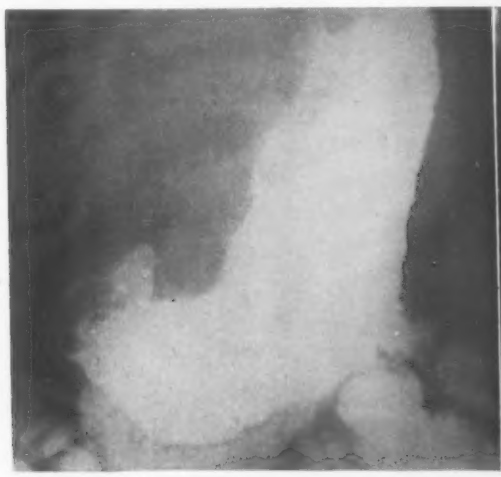

Fig. 5. Spasmodic deformity at pylorus secondary to cholecystitis.

Fig. 6. Deformity of duodenum due to adhesions.

Because of profuse hemorrhages surgical exploration became necessary. No evidence of a gastrojejunal ulcer could be found. As the first portion of the duodenum was buried in adhesions, a pyloric occlusion was done without further exploration.

The roentgenologic diagnosis of gastrojejunal ulcer is notably difficult and a considerable degree of error could have been expected if more cases of this type had had surgical or post-mortem findings.

This summarizes briefly the 100 case records in which the roentgen findings were substantiated or proved incorrect by surgical exploration. Ten of these showed some degree of error in the roentgen diagnosis. Three of the 10 were reported as having a lesion at the outlet but an exact determination of the type of lesion was not made. As stated above, one proved to be a carcinoma, and two were duodenal ulcers. The carcinoma probably should have been recognized as such, but as the growth was located at the outlet, the pylorus could not be identified. It was felt that an ulcer involving the pylorus could produce the deformity which was seen, and the less exact diagnosis of lesion at the outlet was made.

very unsatisfactory, but the obstruction was obvious and a diagnosis of obstructive lesion at the outlet was made, rather than subject the patient to further examination. The other patient presented a pyloric deformity with rapid emptying. As the deformity was characteristic of neither ulcer nor carcinoma an exact diagnosis was not possible from the roentgen findings. However, an examination several years previously had shown a dilated stomach with marked obstruction at the outlet. A clinical diagnosis of duodenal ulcer was confirmed by operation.

Multiple gastric ulcers were diagnosed in 2 cases, the diagnoses proving to be only partially correct in both instances. One patient showed what appeared to be two niches on the lesser curvature, which were present constantly during the roentgenoscopic study and were visible on all films made (Fig. 3). There was also a questionable deformity of the duodenal bulb. A diagnosis of double gastric ulcer and a questionable duodenal ulcer was made. Operation revealed a single gastric ulcer and no lesion in the duodenum. A second patient presented roentgen findings similar to those of the preceding case

(Fig. 4). More careful palpation revealed definite craters at the site of the niches on the gastric outline, and a diagnosis of double gastric ulcer was made. The slight deformity of the cap was disregarded, as it was thought that it could be due to spasm secondary to the gastric lesions. At operation, multiple gastric ulcers and a duodenal ulcer were found.

FIG. 7. Duodenal ulcer perforated into gall-bladder. Barium in hepatic ducts.

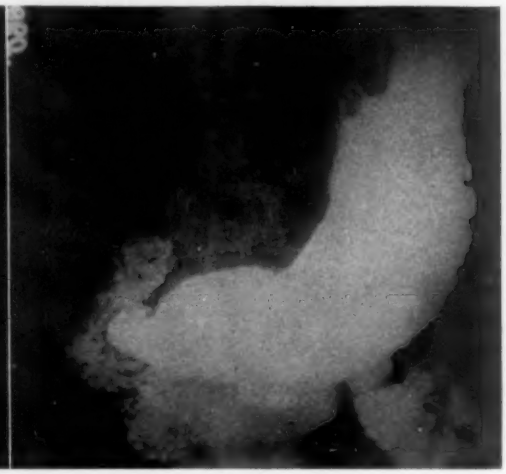

FIG. 8. Gastric ulcer on greater curvature, and a duodenal ulcer.

An incompletely correct diagnosis was made in one additional case. A large filling defect was correctly interpreted as being a carcinoma at the pyloric end of the stomach. At operation, in addition to the neoplasm, a small ulcer was found on the anterior wall of the first portion of the duodenum. A review of the films in this case showed a slight deformity of the duodenal bulb. This was overshadowed by the obvious gastric filling defect, and was overlooked during the roentgen examination.

In the above 6 cases the roentgenologic diagnoses were not absolutely exact according to the operative findings, but the degree of error was not great. In a final estimation of the value of the roentgen examination, these cases cannot be considered as definite errors.

There were, however, 4 cases which were proved to be frank errors in diagnosis. One patient showed on two occasions a deformity of the pyloric end of the stomach, which was reported as "a lesion at the outlet" (Fig. 5). The patient was examined elsewhere not long afterward. Roentgen studies of the stomach and duodenum showed no evidence of deformity. At operation a definite cholecystitis was found, and the stomach and duodenum were normal. Through an error our second examination was made without the administration of an antispasmodic. The deformity seen on both occasions was undoubtedly due to gastrospasm, secondary to the cholecystitis, and would have disappeared if atropine had been given before the reëxamination.

In the second case, the patient was examined twice because of a questionable deformity at the junction of the first and second portions of the duodenum. It was felt that the narrowing at this point was probably anatomical, and the final roentgen report was negative. At operation a large duodenal ulcer was found on the anterior wall of the duodenum, 4 cm. from the pylorus.

Another duodenal ulcer was missed completely. The patient was examined during a time when the roentgen rooms were being remodeled, and the patients had to use the roentgenoscopic room for undressing and dressing. This probably resulted in a hurried examination, without waiting for the proper ocular accommodation necessary for a roentgenoscopic study.

In addition, the patient was rather obese, so that the most careful examination possible should have been given her. It is not surprising that an error was made in this case.

The fourth definite error was unavoidable. The patient was examined in 1925 and again in 1926, showing on both occasions a deformity of the duodenal bulb (Fig. 6). A diagnosis of duodenal ulcer was considered unquestionable. The patient was examined elsewhere soon after our second examination and the same diagnosis was made. At operation, a definite cholecystitis was found with adhesions between the gall-bladder and the first portion of the duodenum. No evidence of duodenal ulcer was seen. The adhesions accounted for the bulbar deformity, which could not be distinguished from the deformity of duodenal ulcer.

This study of errors in diagnosis shows that the chief difficulty arose in the interpretation of abnormal findings. In this group are included 7 cases. Three patients were correctly but inexactly diagnosed as having lesions at the outlet. Two were thought to have multiple ulcers, and the diagnosis proved to be only partially correct in each instance. In 2 further cases, deformity of the duodenum was incorrectly interpreted. One was considered an anatomical narrowing when it proved to be due to an ulcer. The other was diagnosed as an ulcer, when it was caused by adhesions. In the second group, three errors were due to incomplete or careless examinations. The group includes one case in which the examination was not properly done, another in which an antispasmodic was omitted before a "repeat" examination, and a third case in which a duodenal ulcer was missed because it was overshadowed by a carcinoma of the pyloric end of the stomach. The error in the last case was, of course, of no importance, but the other two should not have been made.

In addition to the above cases which are discussed more or less in detail because of some degree of error in the diagnosis, a few others were sufficiently unusual to deserve special mention. One perforated duodenal ulcer was seen. The ulcer had perforated into the gall-bladder, and the barium passed readily into the hepatic ducts during the examination. This case presented no difficulty in diagnosis, as a tree-like shadow could be seen extending upward from the first portion of the duodenum as soon as the barium entered the small bowel (Fig. 7). Operative confirmation of the roentgen diagnosis was obtained.

Fig. 9. Gastric syphilis.

One gastric ulcer on the greater curvature was seen. Examination of the patient showed a typical niche on the greater curvature of the stomach, and palpation during the screen examination revealed a definite crater. There was also a deformity of the duodenal bulb (Fig. 8). A diagnosis of gastric and duodenal ulcers was confirmed at operation.

A third case presented interesting findings. The patient had been explored elsewhere several years previously, and an operative diagnosis of inoperable carcinoma was made. A gastroenterostomy was done as a palliative measure. No tissue was taken for microscopic diagnosis. The roentgen examination four years later revealed slight irregularity of the pyloric end of the stomach, but the gastric walls were flexible and the rugae normal. The gastroenterostomy was functioning freely. The patient was apparently well, her only complaint being constipation. Probably the correct diagnosis in this case was gastric ulcer. Fortunately the gastroenterostomy was

done in spite of the apparently hopeless prognosis, and complete relief of gastric symptoms was obtained.

Two cases of gastric syphilis were seen. Examination of each patient revealed a smooth tubular narrowing of the gastric lumen, one at the pylorus (Fig. 9) and the other in the midportion of the stomach. The flexibility of the gastric wall was retained to some extent, which suggested the diagnosis of syphilis rather than carcinoma. Both patients had positive Wassermann reactions and both improved remarkably under antisyphilitic treatment. One was seen a year later, and showed no change in the gastric defect, although the symptomatic relief had persisted.

SUMMARY

1. Eight hundred and eighty-eight roentgen examinations of the stomach and duodenum were studied.

2. Operative findings were obtained in 100 cases.

3. Four definite errors in diagnosis were found.

4. In the remaining 96, the roentgen diagnosis was essentially correct.

SCLERODERMA WITH SCLERODACTYLIA*

REPORT OF THREE CASES WITH ROENTGEN FINDINGS

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SCLERODERMA is a disease infrequently seen by the dermatologist and internist and less often studied by the roentgenologist. It is described as a chronic condition characterized by circumscribed or diffuse hardening, rigidity, and immobility of the skin. When the involvement is in the fingers it is known as sclerodactylia. It is seen more frequently in women than in men and the majority of cases occur between the ages of twenty and forty. However, there have been a number of cases reported in children under fifteen. Sclerema neonatorum, which occurs only in the new-born, is a different affection with which it should not be confused.

FIG. 1. Case 1.

The exact etiology of scleroderma is somewhat obscure. Trauma and exposure to cold appear to be factors. Endocrine disturbances, particularly of the thyroid and adrenals, are said to play a part. Several observers have found a positive Wassermann reaction in a large percentage of cases, inferring that syphilis may be a cause. However, the consensus of opinion would indicate that it is an angio-trophoneurosis due to disturbance either in the peripheral or central nervous system.

The pathological changes usually described are exudation and swelling around the sweat glands, hypertrophy of connective tissue followed by atrophy of

* Presented before the PHILADELPHIA ROENTGEN RAY SOCIETY, February 7, 1929.

the vessels and epidermoid structures. When the fingers are involved there is absorption and atrophy of bone.

The symptoms and physical signs vary with the areas affected. When the fingers are involved there is pain, swelling and numbness with limitation of motion. The fingers are shortened and deformed; the skin hardened, dry, waxy, inelastic and sometimes pigmented. When the face is involved the skin is smooth and glistening with an absence of wrinkles and furrows, particularly on the forehead, giving an expressionless appearance. There is difficulty in opening the mouth and therefore interference with mastication. When the skin of the thorax is involved there may be interference with respiration.

I have had the opportunity of studying 3 cases of sclerodactylia associated with scleroderma. All were married women of Jewish race. Whether the race is of any significance I do not know, except that certain angio-tropho-neuroses do occur with more than average frequency in members of this race. Their ages were thirty-eight, forty and fifty-two; the duration of the disease three, six, and twenty-seven years respectively.

Roentgenologic study revealed very definite changes in the finger tips, some of which I believe to be characteristic of scleroderma. All three showed atrophy and absorption of the extreme tips of the terminal phalanges giving the appearance of an amputation. Of particular interest in two of the three cases was the presence of small calcareous concretions in the soft tissues of the finger tips while the third showed an increased calcium content of the ends of the distal phalanges.

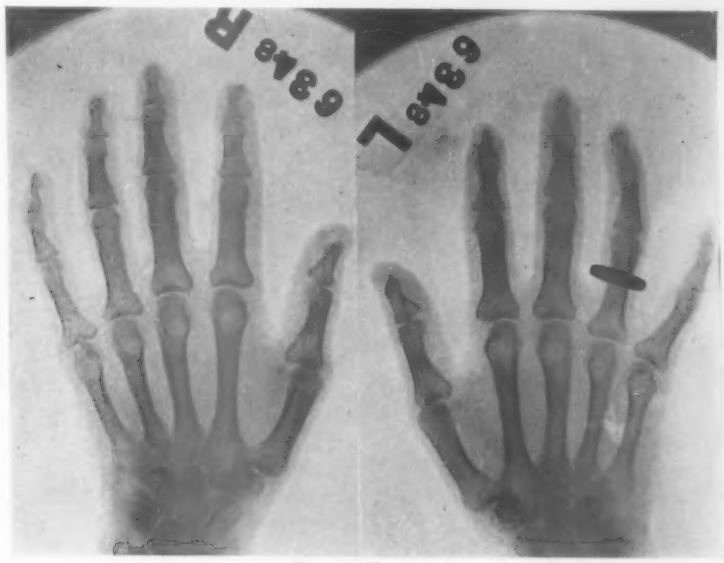

Fig. 2. Case II.

Bone atrophy and absorption of the tips of the phalanges is common in Buerger's disease, Raynaud's disease, leprosy, and ainhum, as well as in sclerodactylia. However, from my own observations and a study of the literature, sclerodactylia is the only condition which will give the roentgenologic picture of calcareous deposits in the finger tips combined with bone absorption of the tips of the phalanges.

Calcareous deposits occurring in the finger tips in cases of scleroderma were reported by Scholefield and Webert[3] in 1911 and Olson[1] in 1917. The latter also summarized the eight previously reported cases found in the literature. These concretions occurred principally in the finger tips but they may also be present in other affected areas. Chemical examination shows them to be composed of calcium carbonate and calcium phosphate. They are densely opaque to the roentgen ray.

While definite conclusions cannot be formed from a study of only three cases, nevertheless the presence of these concretions in two of the three cases would lead one to agree with Olson,[1] who in summarizing said, "More general use of the

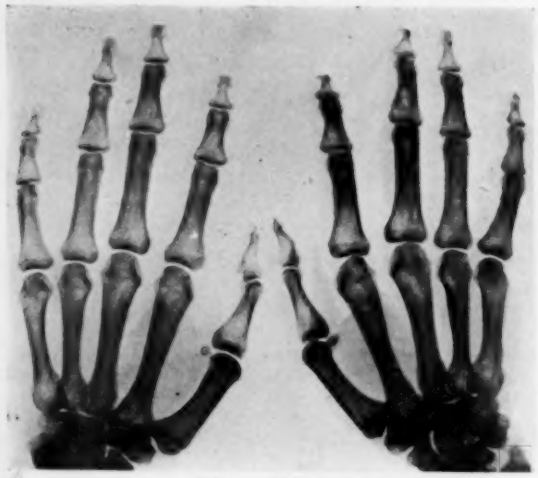

Fig. 3. Case III.

X-ray would probably show that the presence of calcareous concretions is more common than indicated by the few cases reported."

The third case, which did not show the calcerous concretions, did reveal, as previously mentioned, the atrophic changes with complete absorption of the tips. Increased bone density with bone production was observed in the absorbed tips of the terminal phalanges. It is interesting to note in this connection that Pollitzer[2] in 1918 reported a case of scleroderma with true new bone formation in the soft tissues.

The following is a detailed report of the roentgenographic findings in the three cases:

Case I. Mrs. F. C., aged fifty-two, gave a history of three years' duration. Roentgen examination of both hands showed absorption of lime salts in all the bones. The extreme tip of the terminal phalanx of the index finger showed absorption of lime salts and atrophy with a broadening of the head of the phalanx. There were no calcareous deposits in this finger. The left hand showed atrophic changes with bone absorption in the terminal phalanges of the index and middle fingers associatedwith calcareous deposits. Calcareous deposits were present in the soft tissues of the thumb but bone absorption was absent (Fig. 1).

Case II. Mrs. M. M., aged forty, duration six years. The left hand showed distinct and rather marked bone absorption of the terminal phalanges of the thumb, index finger, and little finger, and calcareous deposits in the soft tissues of the thumb, index and ring fingers. The right hand showed calcareous deposits in the soft tissues of the thumb and index finger and no bone absorption, with the possible exception of the terminal phalanx of the thumb (Fig. 2).

Case III. Mrs. S. R., aged fifty-two, duration twenty-seven years. While the duration of the affection was longer in this patient, comparative study showed that the changes observed roentgenologically were not so marked as those in Cases I and II. The terminal phalanges of the index and middle fingers of both hands show marked bone absorption of the tips. The distal end of the remaining portion of the phalanx shows increased bone density and bone production. No calcareous concretions were present (Fig. 3).

In the two patients showing involvement of the feet, no bone changes were observed in the toes. No other areas were roentgenographed.

SUMMARY

Three cases of scleroderma with sclerodactylia are reported. All showed bone absorption of the tips of some of the distal phalanges and one showed increased calcium content in the ends of the phalanges. The other two showed small calcareous concretions in the finger tips. It is the presence of the latter combined with the absorption of the finger tips that appears to be characteristic of sclerodactylia.

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ROENTGEN-RAY PROTECTION*

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AT the Second International Congress of Radiology, in 1928, a set of proposals was adopted covering the broader aspects of roentgen-ray and radium protection. These have since been published fully in several places.[2,3,3a,10] However, certain types of questions very frequently confront the physician and consequently it has seemed of value to discuss briefly several of these questions.

I. SHIELDING FROM DIRECT RADIATION

1. *Perfect Roentgen-ray Shielding.* In the deep and superficial therapy rooms it is most desirable in general that the nurse or technician be completely isolated from the patient since this affords complete protection from both direct and scattered radiation. To realize this practically, the treatment room should be constructed of some completely protective material, and observation by the nurse should be only through amply protecting lead glass.

Two types of such room construction are possible—one using metallic lead walls and the other using walls of protective plasters, such as a barium sulphate plaster. In either case considerable care must be given to the details of construction.

In general the lead wall is the more desirable, but one of the principal disadvantages is that it cannot be installed as neatly as plaster. However, once installed it is much easier to determine its efficacy and one has the assurance that it will never become porous to roentgen radiation. When using a protective plaster, it must be kept in mind that for the same degree of protection one must use a weight of material per square foot at least as great as pure lead and usually considerably greater. It is thus clear that in the proper installation of either, the wall and ceiling structure of a room will not differ very greatly.

In the use of sheet lead, greatest care must be given to the joints, to be certain that there is a sufficient overlapping. It is also necessary to fasten the lead sheet to the walls without leaving any exposed nail or screw holes. This can be done either by covering over the nail heads with lead or by overlapping the nails with the adjacent strip of lead and then burning the lead into place. The latter can be done quite effectively on the walls and floors. Upon completion the sheet lead can be inspected very easily and effectively for "leaks."

A protective plaster must be mixed with great care in order to insure a uniform texture. Moreover it is not easy to know just when a sufficient mixing has been given. Next it must be laid on a specially and carefully installed metal lath and allowed to set under temperature conditions which are preferably quite constant. When all proper precautions are taken a protective plaster installation may be perfect, and yet there is no simple way of determining this in practice, nor is there any assurance that its protection will be lasting. With a very slight settling of the building, cracks are likely to develop in the plaster—very frequently not visible to the eye—and thus be a potential source of danger to occupants of adjoining rooms. We are not in a position at present to compare the relative costs of the two types of protection but it would seem that they should not differ greatly.

Another undesirable feature of barium sulphate plaster is its wide variation of opacity with voltage due to its inhomogeneity. Kaye[9] and Hunt[6,7] have shown curves for this variation. In general there is a maximum roentgen-ray opacity at about 110 kv. which falls off to less than one-half at 200 kv. for thicker walls. Thus for a plaster protection at 200 kv., the thickness will be double that at 100 kv. for the same percentage protection. The opacity is approximately proportional to the thickness of material at lower volt-

* Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

ages but the relation is not so simple at 200 kv.

The lead protective coefficients adopted by the Congress are given in terms of pure lead in Table 1.

Table 1

X-rays Generated by Peak Voltages	Minimum Equivalent Thickness of Lead, Mm.
Not exceeding—	
75 kv.	1.0
100 kv.	1.5
125 kv.	2.0
150 kv.	2.5
175 kv.	3.0
200 kv.	4.0
225 kv.	5.0

2. *Partial Shielding.* The next type of shielding is one that divides the protection into two classes: first, that which protects from direct radiation from the tube and, second, that which protects from the scattered radiation from the patient and surrounding objects.

It must be clearly understood, however, that increase in protection from one source must keep pace with increase in protection from the other. It is inefficient to provide perfect protection from *direct* radiation while neglecting largely the scattered radiation. The two degrees of protection should be so adjusted that their potential danger is about equal. At present the customary protection from scattered radiation is much less effective than from the direct radiation from the tube.

(*a*) Perhaps the least protection is afforded by the lead-glass bowl open on the top. Frequently the thickness and lead content of the glass are insufficient for complete safety when using high voltage roentgen rays, even though the bowl completely surrounds the tube. For diagnostic voltages the glass shields in common use are fairly effective.

Closed glass bowls are now made with lead rubber gaskets so that the only leakage is from the tube stems. While this is not so serious as an open bowl, it is nevertheless undesirable. Otherwise such shields are very good.

In this country the best protection from high voltage direct radiation is afforded by the use of a large lead tank which completely encloses the tube. This has many distinct advantages and until some better method is found it is recommended by the Bureau of Standards for general use. Its greatest disadvantages are its weight and size but by suitable mountings these can be minimized.

For roentgen rays of 200 kv. the tube shield should have a minimum lead thickness of not less than 4 mm. ($\frac{5}{32}$ inch) as taken from Table 1. The commercial shields do not at present carry quite a sufficient thickness of lead even when proper allowance is made for the steel lining. Also the manufacturer frequently undoes much of his good by drilling holes through the shield for steel bolts and then not covering the heads with lead. This practice should be avoided.

There are other advantages of the tube shield. The electrical protection is nearly perfect when the shield is grounded. Also it is very easy and desirable to cover the treatment window with a permanent aluminum or copper filter and a layer of asbestos. The physician is thereby first assured of some protection against the soft rays; second, in case the target should melt off or the tube break, there is no possibility of any hot parts falling on the patient; third, if, when using a water-cooled tube, the water connection leaks or breaks there is no opportunity of a high-tension short circuit occurring to the patient.

(*b*) Much can be said at this time in favor of the *completely oil-immersed* roentgen-ray tube for high voltages, and its development promises to be one of the most important in the improvement of roentgen technique. When the tube and transformer are in the same grounded case the electrical hazard is entirely eliminated. Such a unit is also adaptable to the perfect roentgen-ray shielding.

An important foreign development embodying safety features has been the Metalix type of tube. The center of this tube is made of a chrome-iron cylinder covered with lead except for a small opening about $\frac{5}{8}$ inch in diameter to permit the roentgen rays to leave the tube. The tube is otherwise so constructed that little or no dangerous radiation leaves

it except through the 5/8 inch opening. Thus the tube can be used out in the open without employing any tube shield or other protection. In addition the metal center of the tube can be grounded and thereby brought very near to the patient without danger. For a tube designed to be used in air it marks a very great advance in the art of protection. In its most common form it still has the disadvantage of the exposed high tension leads.

II. PROTECTION FROM SCATTERED RADIATION

Up to the present little has been said about scattered radiation, but it must be emphasized that one must not overprotect from direct while neglecting even in part the scattered rays. Operators should frequently inspect the equipment to be certain that no part of the protection has become accidentally displaced. In diagnostic work the patient needs no special protection from direct or scattered radiation since the exposures are so short and the intervals between such exposures long.

1. *In therapy* the protection of a patient is very important but frequently neglected. Its importance increases for patients having frequent and long treatments. The treatment port on the body should be sharply defined and the remainder of the body carefully covered with sufficient lead rubber in cases where the tube is an open bowl or otherwise poorly protected. For cases where the beam is sharply defined, such as from a large tube shield close to the patient, little or no extra covering for the patient is necessary.

In the case of a patient lying on a metal table, there will be a certain amount of secondary radiation scattered back to the patient from the table. This of course applies to all material and air in the direct beam or in fact near the patient. While in a great many cases this can be neglected, there are times when it must certainly be considered.

It cannot be overemphasized that the operator should remain outside the treatment room at all times when the tube is in operation. The controls must be conveniently located at a point outside the room or in a booth, either of which affords complete protection. Particular care must be given to the lead glass window to insure that it has a high enough protective coefficient. This is neglected in too many hospitals. In addition the window should afford a good view of the patient and high tension meters at the same time.

2. *Protection in Roentgenoscopy and Roentgenography*. The danger from roentgen radiation is probably greater to the physician in roentgenoscopy and roentgenography than from any other source. Roentgenoscopic and roentgenographic apparatus is also used to a much greater extent than any other type and evidently till quite recently it has received the least attention from the point of view of protection. As indicated above, the danger is to the physician and not to the patient. Also the greatest source of this danger is from the *scattered* radiation and not the direct, inasmuch as the latter is usually limited.

We will now assume that the tube is properly shielded in some way outlined above so that only a limited beam of direct radiation strikes the patient. By the use of adjustable diaphragms the field is set at such a size as to be entirely included on the fluorescent screen. Unfortunately this has been considered the best protection or all that was necessary. However, actual observation with a hand roentgenoscope shows a large amount of scattered radiation on all sides of the screen or patient and in the usual positions of the physician.

Measurements of scattered radiation around screening stands have been made by means of an ionization chamber and electroscope. In many cases the dose at the normal position of the physician has greatly exceeded the "tolerance dose." Curves have been plotted showing this distribution and its correction by adding proper screens.

Several direct remedies may be applied and developed to the point where the further increase in safety is inconsistent with construction and general adaptability. There is no sharp line of demarcation for this, and the final solution can only be worked out by the roentgenologist and manufacturer together.

First, the screen itself should be effectively backed with a lead glass of which the protective coefficient is to be deter-

mined by the voltage used. We are unfortunately hampered in this country by the lack of a good lead glass having a sufficiently high coefficient. In order to provide the requisite protection for a screen with the present glass, the roentgenoscopic unit becomes too heavy and cumbersome. In the interests of protection, however, some sacrifice should be made to these factors.

Next, it is desirable that the fluorescent screen have thin sheet lead wings which overlap the glass and extend several inches to each side and top. Beneath the glass, and again overlapping, should hang some form of apron, preferably of lead rubber and so supported that the roentgenologist can reach the patient with his hands when necessary. This would give the roentgenologist very good protection under all conditions. The increase in weight can be counterbalanced so as to permit freedom of motion. All of the protection described above applies principally to radiation scattered from the patient, air and surrounding objects.

In the case of horizontal screening and roentgenography, similar precautions should be taken when possible in regard to the fluorescent screen. A very good protection is afforded the operator with such equipment by extending a lead shield of proper thickness up along the side of and overlapping the patient as far as practicable. If the shield is so mounted as to move with the tube it need be only 2½ to 3 feet wide, otherwise it should extend the length of the table.

3. *Body Protection.* The roentgenologist must at times use certain forms of body protection. In general, however, the permanent protection should be sufficient so that he need only use protecting gloves. The use of aprons, goggles, etc., in a poorly protected room, gives a false security and may lead to carelessness and thus to injury.

For adequate protection, gloves and aprons should have a lead equivalent of 0.5 mm. The rubber should be soft, pliable and kept free from cracks. The requirements for such protection have been discussed sufficiently in the proposals adopted by the Second International Congress.[2,3] It need only be emphasized that in the use of gloves and aprons the busy roentgenologist must use great care and not expect too much of them.

By means of so crude a device as a hand roentgenoscope, a roentgenologist can obtain quickly and readily some measure of the scattered radiation in his rooms. If he first accustoms his eyes to complete darkness for a few minutes and then is able to perceive fluorescence on the screen, he should take some immediate measure to shut off the leakage. In the same way he can examine his other protective materials such as glass and rubber. He should make a habit of examining in the same way all new protective materials which come into his use, as well as those which are subject to change in service, and not rely merely upon the statements of the salesman; faulty material is always a possibility.

III. PROTECTIVE MATERIALS

1. *Lead*, when used in proper thickness, affords ample roentgen-ray protection and calls for no further discussion.

2. *Lead glass* can be made of uniform density and up to 60 per cent of lead without giving too much color. Its manufacture, however, is expensive and the demand is so small that it is not handled by most glass dealers. Of all the samples of lead glass that have come to the Bureau of Standards for test, very few have exceeded a protective coefficient of 0.20 to 0.25. This means that, for an equivalent lead thickness of 3/16 inch, the lead glass must be nearly 1 inch thick and this can be accomplished only by using several plates together. Such a window should be installed in the operator's booth for a deep therapy room when using an open glass bowl around the tube.

3. *Lead rubber* can readily be made with a high lead content but this is not ordinarily done. When containing sufficient lead, and pliable and free from cracks, it affords good protection. Care and judgment in its use must be observed, however.

4. *Lead bakelite* is used to some extent in Europe but scarcely at all in this country. Its use would greatly simplify certain problems. For instance a cylindrical tube shield made of a high lead content

bakelite can be constructed with an inner insulating cylinder of the bakelite covered over with lead. This will make the diameter much less and will correspondingly decrease the weight.

5. *Protective plasters*, discussed above, and in detail as to their merits in papers by Kaye,[8,9] afford real safety only when extreme care is used in their preparation and installation.

IV. THE TOLERANCE DOSE

By the so-called "tolerance dose" is meant the amount of roentgen-ray energy that a person may receive continuously or at repeated intervals without suffering any damage to the blood or reproductive organs. This can be expressed best in terms of r units of radiation or in terms of an erythema dose. The actual values of this dose should be stipulated by the radiologist and not the physicist. It remains for the latter to measure it within certain limits and to devise means for reducing it when necessary. Obviously, the determination of this tolerance dose is very difficult and at best is quite uncertain. The biological factor differs too greatly among individuals to permit the use of a sharply defined tolerance. To be well beyond the danger limit we must apply a generous factor of safety to the result of any physical measurements. Barclay[1] in England, and Mutscheller[12,13] in this country, have contributed notably to the tolerance-dose measurement. Kaye[9] has summed up the tolerance doses as estimated by five investigators and from these data finds that a person may receive without injury up to $\frac{1}{1000}$ of an erythema dose in five days. In each case a generous factor of safety has been allowed. The fact that this figure includes a large safety factor makes it unnecessary to stipulate the quality of the radiation or to state whether the whole body is exposed or only a portion of it.[11]

The determination of the tolerance dose can only be done empirically. A number of hospitals are first chosen as being representative. In each, every worker is carefully examined for any physical damage to blood or tissues. Where they are found to be sound, a careful record of their day is made to determine their exposure to radiation. Next the intensity of the radiation is measured with a sensitive, calibrated ionization dosage meter in terms of r units.[14] Dividing the number of r units by the number of working minutes per day gives the dose in r/min. This can be converted into any desired unit for convenience.

Mutscheller has given formulae for estimating the dose being received at given distances from the roentgen tube. Inaccurate as its determination may be, it nevertheless gives a uniform basis on which to judge the degree of protection, and it enables the same terms to be used in discussing any form of protection or its efficacy. Its adoption marks a definite step in the direction of uniform protection.

V. SOME ELECTRICAL SAFEGUARDS

1. By far the most important electrical precaution is *complete inaccessibility of all high tension leads*. This applies not alone to the permanent aerial system but especially to the flexible conductors from the rheaphores to the tube terminals. These leads are too commonly within easy reach of patient or doctor and many fatal accidents have been due to an excited patient rising on the table and touching the leads. With the recent improvements in apparatus this danger can be entirely eliminated and every effort should be made to entirely abolish exposed leads.

2. It is of great importance that certain parts of the equipment be permanently connected to earth. Occasional inspection should ascertain that these connections are good. Whenever possible, the center point or end of the secondary should be effectively grounded. The non-current-carrying parts of control panels, timing switches, etc., should also be well grounded. When a milliammeter is used in the grounded side of the high-tension circuit it should be shunted by a spark gap set at a distance of 1 or 2 thousandths of an inch. This can be easily done by short-circuiting the meter with two overlapping flat metal strips and then separating the strips with a piece of tissue or cigarette paper. This protects the meter from surges.

3. The question of grounding the tables in roentgenography and therapy is somewhat controversial at present; hence, no fixed rules can be stated. Where the radiologist uses exposed high tension tube leads, the table should be of wood, or be carefully insulated for the whole operating voltage to ground, if metal. With *completely guarded high tension*, every metal part should be grounded, and either wood or metal may be used for tables, stands, etc.

4. The question of complete insulation of every piece of electrical equipment in a roentgen-ray room is perhaps desirable theoretically but its practical attainment is quite difficult. Hemler[4] has discussed in detail many of the important aspects of such an installation. However, there seem to be several distinct drawbacks. The expense will in general exceed by a considerable amount that for the more usual type of installation. The reasons for this are obvious when one considers the thick walls, wood peg construction, paraffin impregnation of wood, etc. Again, in order to have such thick floors and ceilings, it will frequently necessitate a loss of head room unless proper alterations are made in the building itself. These distances between floor and conductor have been specified in the International Proposals to be greater than 9 feet.

The complication of the installed roentgen-ray apparatus must necessarily increase and in some cases become more cumbersome. For instance, any hand or foot switch must function through an insulation transformer. Similarly lamps for illumination which are within reach must be led in through insulation transformers.

Any such material as is depended upon for the complete insulation of the room is apt to deteriorate or become faulty. The nitrous-oxide fumes given off in a roentgen room attack paraffin-impregnated wood and similar insulating materials. Moisture is easily capable of rendering the surface of such materials sufficiently conducting to start a voltage breakdown. In other words there are many contributing causes to an unexpected and dangerous spark-over.

5. Insulating floor coverings are always desirable and are a necessity on concrete floors. Very good grades of rubber compound flooring or mats are made which will stand a breakdown voltage of over 100 kv. through the body of the material. It should be laid preferably in strips as wide as possible so that a discharge cannot take place along the surface to an edge or crack. It should be installed carefully so as to avoid cracking or straining, and the edges should be 1½ to 2 feet from the foot position of the operator when possible. When being cleaned, acid or strong soapy solutions should not be used. Wiping should be done only with a damp rag and moisture should be kept from under the edges; dry thoroughly before using. Where in addition roentgen-ray protection is desired for a room beneath, a lead rubber flooring can be used effectively to serve both purposes.

6. In some forms of apparatus the main transformer is easily accessible and the high tension is conducted away through insulating tubing. Where such leads are also accessible they should be covered with a carefully grounded metallic sheathing. This eliminates any possible danger from shock in case the insulation breaks down.

7. In diagnostic equipment one of two types of switch should be used in the transformer primary circuit, namely, either a hand or foot switch so constructed that the circuit is instantly broken when the pressure is relieved; or a time switch which automatically opens the circuit at the end of a set interval. Wherever possible two switches should be used in series to minimize the danger of accidentally closing the circuit. This is less important with a completely protected equipment. The switch cases should in addition be carefully grounded.

It is also very desirable to have in the transformer primary, double-pole magnetic circuit breakers. The tripping current should be adjusted to a value slightly above that necessary for normal operation of the equipment. Thus, if a spark-over occurs to the grounded guards or to a person, the voltage will immediately go off, thus preventing damage to the equipment and minimizing danger to the person.

8. Duplicate milliammeters in series

should always be used and both should be within easy view of the operator. Their calibration should also be checked occasionally. It is always advisable to have these meters protected with a short-circuiting gap as indicated in Section V-2.

9. In the use of insulated water-cooling systems every precaution must be made to prevent leakage of water. In particular any leakage must be prevented from striking the patient, which might cause a short circuit of the high tension. This has been discussed above in connection with the lead tube shield.

10. Much can be said for the development of completely insulated equipment and especial credit is due the manufacturer for his efforts in developing it. One of the most important developments is the *completely oil-immersed* units in which tube and transformer are in a common metal tank, air-sealed and effectively grounded. The electrical hazard in the better types vanishes. A number of such units are now being manufactured up to 90 kv. and undoubtedly will soon be made for any voltage.

11. A new type of screening apparatus has the tube and transformer in air but enclosed entirely in a grounded metal cabinet so that it is inaccessible while the voltage is on. Developments along this line are also of value.

With the Metalix tube mentioned above, the center cylinder can be grounded and so be brought very close to the patient without danger of shock. This marks an advance over the present exposed tube but the leads are still exposed and are a source of danger. The use of flexible metal-sheathed high tension cables when properly installed eliminates the danger due to the leads. Such cables can also simplify the construction of other types of apparatus and increase their general safety.

The use of such deep therapy equipment as the "Holfelder Cannon"[5] in Germany gives evidence of the effort being directed towards safety. While such apparatus is perhaps expensive and cumbersome it is indeed extremely safe from all hazards and its development is therefore to be encouraged.

England has perhaps carried protection further than any other country and several of these suggestions have come from the British X-Ray and Radium Protection Committee. The writer wishes to express his appreciation for the suggestions made by Dr. Kaye and Dr. Melville.

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EXPERIENCES TO DATE WITH THE FOUR-GRAM RADIUM ELEMENT PACK*

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THE evolution of external irradiation with radium has been a gradual one. Because of the limited knowledge of the physics of radium in the beginning, the applicator was placed in contact with the body, either in the form of a plaque, without filter, or in tubes, with very little filter. The change to the more distant, filtered, applicator was further impeded by the lack of sufficient radioactive material, even after adequate knowledge was accumulated to indicate such usage. Later the filtration was increased to 2 mm. platinum, or to 3 mm. lead. This was the maximum used for routine treatment. At the present time, 2 mm. brass is so widely used that this filter, or its equivalent, may be considered the standard thickness. It is probably the optimum filter for the efficiency and the economy of the source radiation.

The Memorial Hospital has had for many years 4 grams of radium element, as radium barium bromide, which has been in solution. This was used to provide radon for the various types of applicators, including gold tubes, uterine tandems, etc. Allowing for the radon used for interstitial irradiation, there remained an average of 2000 mc. each day for pack treatments. With this amount of radon available, it has been possible to give relatively large doses of external irradiation.

Fifteen months ago, 4 grams more of radium were added to the hospital supply. This is in the form of the insoluble radium sulphate, and is used exclusively for external irradiation. For this large amount of radium, a special pack is required for the protection of the department personnel. Such a pack was devised by Failla. Not only is adequate protection afforded but the pack is easily placed and maintained in position. Since the mechanical features of this pack have been fully described by Failla[1] a repetition is not necessary at this time.

During the irradiation of the patient, the operator remains in an adjoining room, protected by a heavy lead door. Frequent observations of the patient are made through a small opening in the door. The opening is covered by a heavy piece of lead attached over a pulley to a counter weight. The weight of the lead is in excess of the counter weight, so that the small opening is covered except during the observation period, that is, a few seconds every fifteen minutes.

That the operator is adequately protected by the heavy lead of the pack itself, with the added protection from secondary rays from the patient by the lead door, is shown by the photographic test, which has been carried out by Dr. Edith Quimby of the physical department of the hospital. She has shown that the operator receives 0.00004 per cent of an erythema dose per day. This includes the amount of radiation received during the setting up of the patient, both the direct rays from the pack, and the scattered rays from the patient, and the very small amount that penetrates the lead pack and lead doors.

On the inside of the lead door, 0.00024 per cent of an erythema dose is absorbed per day. This is mostly the scattered radiation, for on the outside of the same door only 0.00005 per cent is absorbed. An estimate of the radiation at the desk where the operator sits during the treatments shows an absorption of only 0.00001 per cent per day. It is obvious that the personnel of the department is adequately protected.

The pack may be approximated to any part of the body at either 6 or 10 cm. radium distance, and at greater focal distances, by allowing for required space

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* Read at the Thirteenth Annual Meeting, AMERICAN RADIUM SOCIETY, Minneapolis, Minn., June 11–12, 1928.

between the external port, and the body. Roughly estimating the size and depth of a tumor in the body and then prescribing a skin dosage is inadequate. An erythema on the overlying skin gives no idea of the absorption by the tumor. Though we are concerned with the amount of radiation not tolerated by the skin, we are equally concerned with what the tumor will not tolerate, and also the effect of the absorbed energy on those organs in the path of the radiation beam.

The patients vary greatly in size, and no standard chart can give more than a rough estimate of the absorbed radiation at a given layer. Careful palpation and mental visualization will give more accurate information than a composite cross-section anatomy chart. Though it is a time-consuming procedure, the only reasonable method is to make an individual cross-section anatomical picture for each patient.

The photographic department of the hospital has prepared a series of lantern slides from a classical text of cross-section anatomy. With the aid of a special projection apparatus, the required cross-section is traced at the size of the patient that is to receive the treatment. The apparatus for this consists of a table, on one end of which is supported an upright ground glass. Behind this are a focusing lens and a light projector, running on a track, and controlled on an endless chain. The light projector carries the slide holder. By varying the distance of the light projector and slide, the image on ground glass can be varied from a very small one to one that will conform to the largest patient we have to treat. The lens, moving separately, will focus the image at any size required (Fig. 1). The body contour and the various organs are traced on special paper. The tumor is then drawn schematically in red ink.

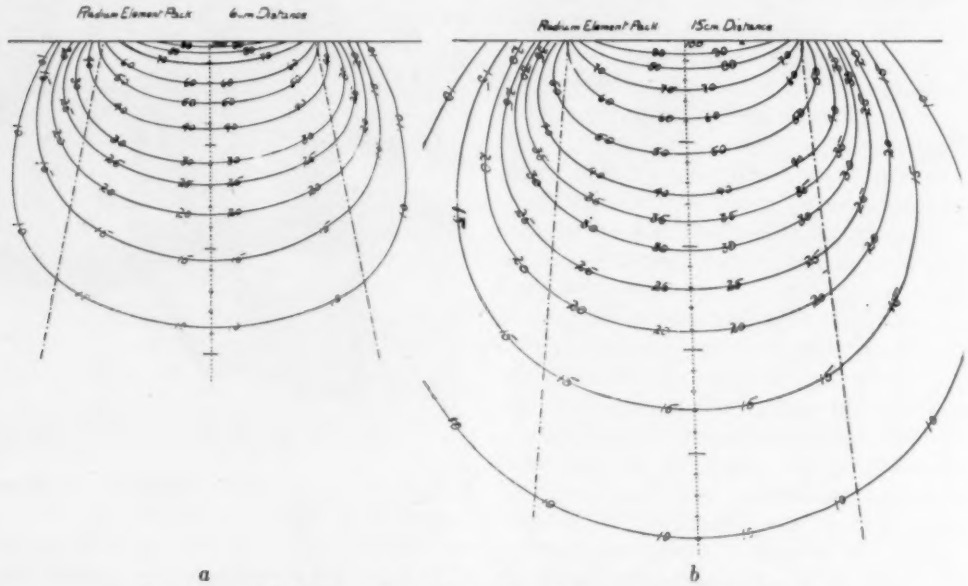
With the aid of a glass top table, electrically lighted from below, the dosage charts for the various distances will quickly and accurately show the radiation beam and the amount of absorption at the different levels. The calculation of two or more beams of radiation is more time consuming, but does not alter the determination of absorption at any given point or points.

The projection method is not suitable for several regions of the body, namely the breast, axilla and supraclavicular region, because of the great variation in size and contour. The pendulous breast presents a picture markedly different from the small,

Fig. 1. Apparatus for projecting cross-section slide.

firm breast. Proper visualization would be impossible by projection of the cross-section picture. The axilla, variable because of the pectoral muscle, does not lend itself to a drawing from the cross-section anatomy chart. Because the supraclavicular region is irradiated from an angle, that is, downwards and slightly inwards, a special contour drawing is required for the proper orientation of the radiation beam. For these regions a flexible rod is used. The contour is obtained by pressing the rod over the surface. It maintains its contours till a transference of the lines is made to the paper. Palpation determines the size and depth of the tumor. This method of tracing the contour is especially applicable to the axilla, because a metastatic node may appear anywhere from just beneath the pectoral muscle to the very apex of the axilla. Were a cross-section drawn through the lower part of the axilla for a node beneath the pectoral muscle, the radiation beam would be directed at an angle, and the true depth dosage could not be ascertained. By drawing a sagittal section of the axilla, either one beam of radiation can be used and dosage calculated, or two radiation beams, anterior and posterior, can be used and total depth absorption determined.

The absorption at any point or points, is ascertained by a system of dosage charts (Figs. 2*a* and 2*b*). These show the percentage of absorption for 6 cm., 10 cm., and 15 cm. distances of applicators at each centimeter layer. Not only is the central radiation beam included, but the absorption of the peripheral scattered rays is shown. By placing these charts beneath the scale drawing, with transmitted light, the absorption is charted. If two or more beams of radiation are used, the total absorption, at the chosen points, is determined. In our determinations, five points are calculated, the center, the nearest and farthest points of the tumor, and two lateral points. This gives us a fairly comprehensive idea of the volume absorption by the tumor.



a *b*

Fig. 2, *a* and *b*. Dosage charts for radium element pack at 6 and 15 cm.

The early concept that radiation had a selective action on tumor cells is not now tenable for all types of neoplasm. It is true for the embryonal type of tumors, and to a slightly lesser extent, for the very cellular tumors with adult types of cells. From these very susceptible tumors, there are gradations in susceptibility, from the very sensitive, to the very resistant types, such as squamous cell carcinoma, osteogenic sarcoma, etc. Unfortunately most of the tumors are more or less resistant. Moreover they are deep-seated, being anywhere from 2 to 3 cm. below the skin, as metastatic cervical nodes from intraoral carcinoma, to the mediastinal new-growths in thick-chested patients and the intra-abdominal tumors in the stout patients.

To deliver the same source dosage over a different region does not mean the same tumor dosage. The skin in each case may absorb the same amount of energy, but the tumors absorb vastly different amounts. It must be admitted that we are deeply concerned in administering that amount of radiation which the skin can tolerate, but we are just as much concerned with the intolerance of the tumor to radiation. It is this intolerance to radiation that makes a cure possible. If the dosage in the tumor is not calculated, nor a procedure devised to deliver a dosage estimated to be adequate for the lesion, we have failed in our duty to the patient in particular, and in general, we have failed in advancing the science of radiology. We know in a rather general way the lethal dose for the normal structures of the body, but our knowledge of the lethal dose for the various types of tumors is very inadequate. The report from the pathological laboratory on biopsy material, as to the radioresistance or the radiosensitivity of

the tumor, is, at best, of only moderate assistance in the conduct of the case. Even in the more radiosensitive tumor there is a narrow margin of safety between that amount of radiation which will sufficiently injure the tumor cells to assure the complete local regression, and that amount of radiation which will injure the surrounding tissue. If this is true for the susceptible type of tumor, then the problem of treating an adult type of new growth is more difficult, for the normal structures around a squamous, hornifying carcinoma are no less vulnerable than the structures surrounding a lymphosarcoma. It is necessary then to concentrate two or more beams of radiation on a tumor mass, without overdosing normal tissue. This cannot be done by following a standard technique, but each patient must be studied and a procedure formulated.

At Memorial Hospital, we have attempted to individualize the cases treated with the 4-gram element pack. When a patient is referred for this external irradiation, measurement at the proper body level is taken, and an appointment made for treatment. Before he returns for treatment, the tracing of the body and organs is made and the tumor drawn in according to scale. Then with the transmitted light equipment, the several depth dose charts are maneuvered until it is learned at what distances the radiation must be given and the number of ports required to administer the determined dosage. If the direction of the several beams is indicated on the graphic chart by an arrow, it is not difficult for the operator to properly apply the pack.

Since we are limited in the amount of radiation to be given through any one port by the tolerance of the skin, it is necessary to first learn what this skin dosage is. With the 4-gram element pack these amounts are 16,000 mg-hr. at 6 cm. distance; 28,000 mg-hr. at 10 cm., and 60,000 mg-hr. at 15 cm. distance. It is most uncomfortable for a patient to remain immobile for more than two hours, so the duration of each treatment is limited to this time. The above amounts of radiation are for consecutive daily exposures of two hours each. The difference between the effect of 16,000 mg-hr., given in consecutive hours, or divided and given in equal parts on two consecutive days, is so small that it is not appreciable. But when we give large amounts at 15 cm. distance, increasing the interval between exposures

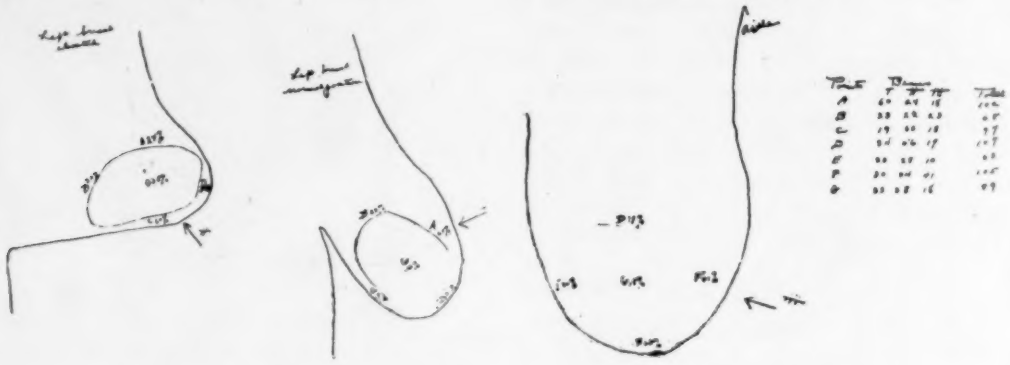
Fig. 3. Small breast with tumor treated at 15 cm. distance through one port.

to three or four days, there is an obviously less effect than when the total through two ports is given in fifteen days, the usual time consumed in such a treatment. The cases of rectal carcinoma have best demonstrated this to be so, because the lesion, though deep-seated, not only may be palpated, but also may be seen. In those cases that were given the full amount in a short period, there was an intensive hyperemia of the mucous membranes, with slight edema, followed by a membranous covering in the ulcerative portion of the resistant type of lesion, and definite regression in the less resistant type. When the same dose was given over a period of three to five weeks, little effect could be noted by palpation, and there was no visual change. The same variations were seen in the oral group of carcinoma, when there had been a delay in completing the total dosage.

Unless a tumor is very susceptible to radiation, we cannot expect to obtain complete regression by using one beam of radiation. It is impossible for the tumor to absorb more than the skin. We may deliver more than a 100 per cent of a skin erythema dose to a subcutaneous tumor, but to do so the skin receives more than a 100 per cent dose. Increasing the focal distance of the applicator does increase the depth dose, but not very much in the superficial

layers. It is more marked in the deeper layers. The accompanying illustration (Fig. 3) shows the depth dose in a tumor of a small breast, treated at 15 cm. It could be treated in only one direction. The source dosage was 60,000 mg-hr. Compare the

The pelvic organs are common sites for neoplasms requiring external irradiation. This region presents difficulties because of its varying sizes and contours. It is nearly always the largest part of the body. It is of course always necessary to irradiate at a



a *b*

Fig. 4, *a* and *b*. Large, pendulous breast treated from three directions. Dosage at several points is totalled.

absorption at the different points, with the absorption in a large tumor in a pendulous breast (Figs. 4*a* and 4*b*) irradiated from three directions, from below with the breast lifted, anteriorly, and laterally. The total source irradiation was 48,000 mg-hr., that is 16,000 mg-hr. in each direction. In the first case, that of the small breast, the greatest absorption was 85 per cent, and the least was 52 per cent. In the large breast, the greatest absorption was 107 per cent, the least, 63 per cent. The more efficient irradiation was done with 80 per cent of the source radiation that was required for the small breast.

15 cm. distance, increasing the number of ports, rather than the distance, to increase the absorption at a depth.

Figure 5 represents the pelvis of a medium sized patient, with advanced carcinoma of the cervix uteri. Directing two beams of radiation, an anterior and a posterior, towards the cervix at 15 cm. source distance, and each for a full erythema dose, gives an absorption at the center of 64 per cent of an erythema dose.

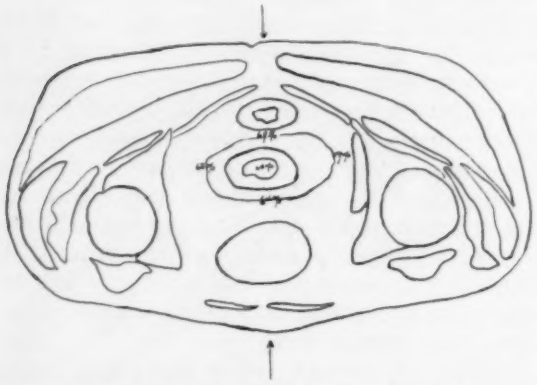


Fig. 5. Advanced carcinoma of cervix, treated through anterior and posterior ports, at 15 cm. distance.

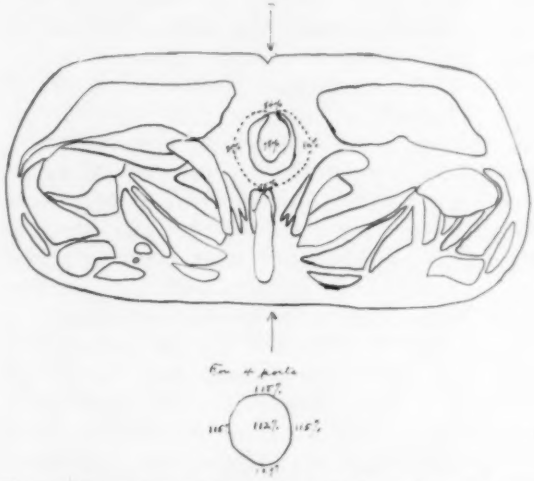


Fig. 6. Rectal carcinoma treated through two ports. Insert shows tumor dosage if two lateral ports were added.

Adding two lateral ports for this patient would increase the depth dosage at the center only 32 per cent. In other words, the source radiation would be increased 100 per cent to add 32 per cent to the depth dose. This would be extravagant use of radium in a busy clinic, unless it were impossible to treat the lesion intracervically.

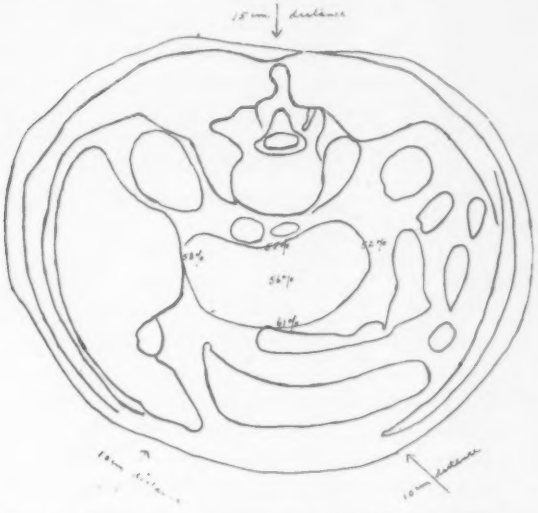


Fig. 7. Abdominal mass treated with different distances of radium applicator, both conserving radiation and increasing tumor absorption.

External irradiation offers more to patients with carcinoma of the rectum, as a group, than to those with other types of lesions. The foremost reason is that rectal carcinoma is more common in the male, whose pelvis is smaller, notably in the lateral diameter, so that the anterior and the posterior pelvic exposures give greater absorption in the center of the tumor, and by adding the lateral exposures, a definite increase of depth dosage is obtained.

Figure 6 is a cross-section of a medium sized male with fairly bulky rectal carcinoma. With anterior and posterior beams of radiation, the center of the tumor absorbed 78 per cent of an erythema dose. Two lateral exposures increased the absorption to 112 per cent in the center. Because it is more difficult to properly distribute gold tubes of emanation in a rectal growth, than to place the platinum tandem in the cervix, it is justifiable to use four ports for the application of external irradiation. Moreover, a smaller pelvis in the male allows a greater percentage absorption for the total source radiation used.

In a recent case of teratoma of the testis, with a large upper abdominal metastasis, which was nearer the abdominal wall than to the posterior surface of the body, there was a more even distribution of absorption throughout the tumor by using two 10 cm. distant ports anteriorly, obliquely directed toward the tumor, and a 15 cm. distant port in the center posteriorly (Fig. 7). The average absorption in five points of the tumor, using three ports, was 55⅖ per cent of an erythema dose, and by using two 15 cm. distances, the average was 53⅖ per cent of an erythema dose. With the three ports the maximum absorption was 61 per cent, the minimum 50 per cent. With the two 15 cm. ports the maximum absorption was 57 per cent; the minimum 50 per cent. Besides obtaining a better total absorption, by using three ports as shown in Figure 7, 10,000 mg-hr. of radiation was saved, that is 2½ clock-hours of treatment.

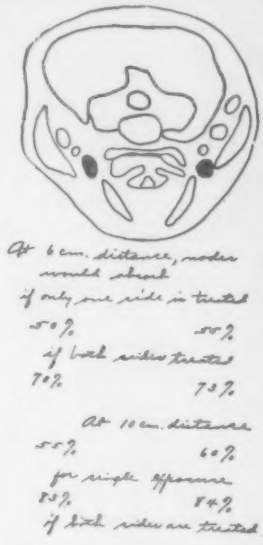


Fig. 8. Cervical nodes under sternomastoid muscles treated from one or both sides, at 6 and 10 cm. distances.

In the treatment of intraoral carcinoma, it is a routine procedure to irradiate both sides of the neck, whether or not there are metastatic nodes to be felt on either or

both sides. Because bilateral dissection of the neck was the accepted and routine surgical procedure for intraoral carcinoma it naturally followed that the newer radiation treatment should include both sides. Bilateral irradiation of the neck is founded on a more reasonable basis than the possibility of bilateral metastases, or the unusual cross metastases, of an intraoral carcinoma. In Figure 8 the percentage absorptions are given for the irradiation of the respective sides of the neck, and then for the total absorption for both sides, both at 6 and 10 cm. distances.

The absorption in the center of a node under the right sternomastoid muscle is 50 per cent, under the left sternomastoid muscle, where the node is slightly more superficial, it is 55 per cent, if either side alone is irradiated. When both sides are irradiated, the total absorption in the center of the node on the right is 70 per cent, and on the left side, it is 73 per cent. This is an increase of depth absorption of 40 per cent, and the focal distance is 6 cm. When the focal distance is increased to 10 cm., the absorption, to either node by one exposure, is only slightly augmented but the bilateral exposure increases the depth dosage in each by 50 per cent.

In the administration of these various doses, we have given thought not only to the irradiation on the skin, but have just as seriously considered the absorption at the depth of the tumor. As yet we have not determined what is the lethal dose for any definite type of cell. The much heralded lethal dose for carcinoma and for sarcoma is far from correct. Many carcinomas have received more than the 110 per cent of an erythema dose, and have continued to show activity clinically, and little irradiation effect microscopically. In our present state of knowledge, we are justified in administering all the radiation that the patient as a whole, can tolerate, at the same time protecting any interposed vital organ. During the calculation of the doses in the various regions, we have been impressed by the application of the knowledge we have of the absorption at the various levels beneath the skin. It is very well known that the absorption in the first few centimeters of tissue does not vary greatly for the applicator at 6 cm. and 10 cm., or at 10 cm. and 15 cm. distance. Even the difference in superficial absorption for the 6 cm. and 15 cm. pack seldom justifies the large dosage for a fairly superficial lesion, when the added injury to the deeper structures is considered. Let us cite as an example a carcinoma of a small breast. The growth, $2 \times 2 \times 1$ cm. is 3 cm. below the skin, at its greatest depth. Using the 6 cm. distant pack, the deepest part of the tumor receives 50 per cent of the skin irradiation. Increasing the distance of the applicator to 15 cm., the dosage to the same layer is 66 per cent, while the lung at 10 cm. depth receives 121 per cent increase of depth irradiation, the percentage increase in irradiation to the tumor is only 32 per cent. Moreover $3\frac{1}{2}$ times the source radiation must be used to obtain the added absorption. The same increase of tumor absorption may be had by giving 130 per cent of an erythema dose to the skin. Normal skin will regenerate more quickly and with less adverse body reaction following a first degree erythema, than over-irradiated lung tissue. Too penetrating irradiation adds a great deal of injury to deeper normal tissue, and very little increase of absorption in the more superficial normal tissue.

The same care and consideration which are given to treatments in the thoracic region, must be given to the treatment of lesions either in the abdominal wall or within the abdominal cavity. The amount of irradiation that the small intestine can tolerate is definitely limited. We have all seen patients, over-irradiated in the abdominal region, who present severe toxic symptoms, even more than could be attributed to the concomitant ileus. In the more severe cases there is a peritonitic syndrome. This type is usually fatal. If the proper calculations were made before instituting the therapy, such sequelae would not occur.

We may not know at present the exact amount of radiation that will produce such dire results in abdominal therapy, but proper calculation by cross-section drawing will be at least a step in the right direction. This procedure demonstrates to us the organs irradiated by any beam or beams

of radiation, as well as the total dose at any point. It is only by such measurements that we shall be able to estimate the required dosage in the different types of tumors.

These few illustrations would seem to indicate that a routine procedure for each region of the body is totally inadequate. Because one, or two or three areas of the body over a tumor have been reddened by irradiation is not evidence that the growth has been properly treated. Unless further effort is made to determine the tumor dosage, correlating the absorption with the microscopical cell study and the clinical course of the disease, progress will be extremely slow.

ABSTRACT OF DISCUSSION

Dr. Hayes E. Martin, New York City. One of the most important possibilities of this pack is that we have a fixed applicator in which all factors are always the same. In calculating dosages and their effect upon different tumors, I think that we will be able, in the future, to determine relative radiosensitivity of different tumors better than with any other applicator. In my experience with it, I have found that the screening which protects the patients from the body dose permits heavier local irradiation. This protection is much greater than with the roentgen rays or with our old pack.

Dr. Curtis F. Burnam, Baltimore, Md. Evidently the apparatus is one that protects the personnel in an excellent way. I am sorry I did not have an opportunity to see the paper beforehand, for I am not prepared now to discuss the figures presented. We believe that, dosage by dosage, the clinical results are better with the radium used in this way than by the roentgen ray in our hands. I do not believe that there is any advantage in the French method of prolonged irradiation with smaller amounts over the greater dosage given in a short period of time.

Dr. K. Wilhelm Stenstrom, Minneapolis, Minn. It seems that the depth dose with this pack is not nearly that which we can get with roentgen rays, so the reason for using this pack in place of the roentgen ray should be the assumption that the radium works in a different way. Personally, I am skeptical about that but know there are differences of opinion.

Dr. George E. Pfahler, Philadelphia. I would like to have Dr. Duffy tell us what the clinical results have been as compared with the high voltage roentgen therapy. So far as the figures indicated by the chart are concerned, it would seem that he is not getting the depth dosage which we get with the roentgen rays. It seems that this very expensive equipment would have to be justified by some great differences in results as compared with the high voltage roentgen therapy. In principle Dr. Duffy is trying to carry out the ideas we have been using in connection with high voltage roentgen rays. If there is not sufficient improvement in clinical results it does not justify efforts to get the 4-gram pack for use.

Dr. H. H. Bowing, Rochester, Minn. We are all watching with interest the 4-gram pack method of treatment, and the ultra-scientific way in which they are using it at the Memorial Hospital. There is one feature which I am sure those of us who have had the privilege of using small amounts of radium will appreciate, and that is the time factor. My experience is purely clinical and not based on any chart or physical measurements but, for example, to treat very large abdominal tumors, as well as thoracic tumors, with small amounts of radium for a long time and see the tumors respond under that technique must be explained. Whether we can balance up the results with the 4-gram pack over short periods with the small amounts for long periods must be decided in the future.

Dr. Henry J. Ullmann, Santa Barbara, Calif. The point I have not yet heard brought up is the economical one. We must know whether the large pack method is bound to yield better clinical results, and is not purely a research proposition. Some rapid calculations just now showed that 6 per cent interest on the cost of the radium and operating fifteen hours a day would amount to a cost of $3.00 an hour for the radium alone and few institutions treat enough patients to keep going so many hours a day. This does not include the cost of the personnel, which would probably more than double it. If it is worth while, we must have centers, either through public subscription or state appropriation, where such treatment can be available. We must not have these packs limited to only one or two institutions for experimental purposes. I think this should be our thought before determining to go out to the public and ask for larger quantities of radium.

Dr. J. D. Morgan, Philadelphia. A similar pack has been used for many years in the Curie Institute in Paris, and although I have not the data as to their latest clinical results, I believe there has been definite improvement, in the pelvic cases particularly, following the use of this pack. I do not know whether they have decided on an explanation for this improve-

ment, whether the short gamma rays have a more potent action than the high voltage radiation, or whether it is due to prolonged treatment, in accordance with Regaud's theory. I think that the small doses over long periods give better results than the heavy doses for short periods.

Dr. Duffy (closing). Dr. Stenstrom spoke of the difference of absorption of roentgen and radium radiation. Our physical measurements show that roentgen rays at 200 kv. with 0.5 mm. copper filtration and 50 cm. target skin distance, give a 1 per cent greater absorption at 11 cm. depth, than the radium element pack at 15 cm. distance. At the lesser depths, the roentgen rays permit a relatively greater absorption.

In response to Dr. Pfahler's question, I would say that with radium we obtain better clinical response. Whether or not this is due to the selectivity or intensity of the radiation will have to be shown. With the small dosage given over long periods of time, our clinical results have not been so good.

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Information of interest to all readers will be found on page ii.

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EDITORIAL

THE STORAGE OF ROENTGEN-RAY FILMS

THE recent catastrophe at the Cleveland Clinic resulting from the ignition of roentgen-ray films was most lamentable. After the first shock resulting from the great loss of life was over there was aroused in the minds of all roentgenologists a sharp realization of the necessity for the most stringent precautions in the future to obviate fire hazards from roentgen-ray films. The governing boards of all hospitals equipped with roentgen laboratories must take prompt action in this matter. The directors of private roentgen-ray laboratories located in office buildings and in houses must also assume their responsibility. It certainly is most unfortunate that such a momentous disaster was necessary to arouse general interest in proper safeguards in the handling of roentgen films.

History repeats itself. The danger of fire and panic in the motion picture houses led to the drastic regulations which have apparently abolished the fire hazards to audiences in the moving picture theaters. The use of the cellulose nitrate films in the standard moving picture theater has been so safeguarded by the fire precautions which are carried out by the management of these theaters that the problem may be regarded as solved. Then, too, the universal use of the safety film has made possible the most extensive use of moving pictures by amateurs in private houses. The experience which has been gained in the handling of this older problem will afford valuable help in the study of the present situation.

It seems almost inevitable that legislative bodies will prohibit the use of the cellulose nitrate films in hospitals and in laboratories located in buildings where many persons are exposed to this danger. The question of the added expense should not enter into the matter at all. The public will not object to a slight addition to the cost of examination if safety can be assured. In this connection it is interesting to recall that in 1896 it was predicted that the diagnostic use of the roentgen-ray would never come into general use in hospitals on account of the cost to the patient. Inasmuch as the general public has already assumed the responsibility of paying for these examinations it will follow that the slight additional cost will not be an obstacle in the further development of roentgenology. Legislation in this matter should extend to private laboratories, especially those that are located in office buildings. The writer has seen quantities of inflammable films stored with no precautions in a large office building. Experience has taught us that the cellulose nitrate film is a distinct hazard and its use and storage should come under appropriate regulations.

Another phase of the problem which arises is the question of storage of negatives which are a part of the patient's clinical record and which are of value in studying the history of the case. Some of the films have important legal aspects and others again must be considered useful from a teaching standpoint. The ideal way to handle the problem is to store the films in a separate, detached building removed a safe distance from the main hospital. In hospitals located in private communities such a procedure is often impracticable. Some fire marshals and hospital superintendents have considered that the storing of films in small buildings located on the roof of the structure is a safe procedure. Such a location removes most of the danger from the noxious gases, but the fire hazard still remains. Anyone who has had experience with film fires knows that the combustible films generate a very high temperature when they burn. It is therefore imperative that if roentgen films are to be stored on hospital roofs adequate

measures for ventilation and fire protection must be carefully carried out.

Furthermore, it must always be remembered that no matter how thorough are the precautions taken against fire hazards the human equation still remains an important part of the problem. The writer knows of a fire which started in a hospital in the Middle West. Careful investigation showed that it was of incendiary origin.

Many of the precautions which are insisted upon in the storage of roentgen films, such as the use of automatically closing fire doors, sprinkler systems, etc., must, in reality, be regarded as protection against the ingress of fire into the film storage rooms. If, however, a fire originates among the films the fire door and the sprinkler system must be regarded as of doubtful value. They are of course useful in the general study of the problem, but must be regarded as of only minor importance. The question of adequate ventilation of the film storage room is entitled to first consideration. The use of insulation walls is also of vital importance since the fire hazard is reduced by not allowing the room temperature to rise. It is evident that architects who specialize in hospital construction must now give more attention to the planning of roentgen departments than they have in the past. Poorly ventilated illuminating boxes have been a source of fire hazard, but with the use of the safety film this danger will become negligible.

It is to be hoped that, in the adoption of rules and regulations concerning the storage and care of films, legislative bodies will seek proper counsel and study the problem carefully from all angles before taking action. As an example of ill-advised action, in one city an ordinance prohibits more than six x-ray films being used in a laboratory at one time, and, as the reading of the ordinance simply speaks of x-ray films, the fire marshall is left no jurisdiction between cellulose nitrate films and cellulose acetate films. The writer feels, however, that roentgenologists will face the importance of this special problem and that the solution will achieve the greatest good to the greatest number.

Preston M. Hickey.

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SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan Ave., Toledo, Ohio.
Thirtieth annual meeting: Hotel Pennsylvania, New York City, Sept. 17–20, 1929.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Portland, Oregon, 1929.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Portland, 1930: To be announced.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Walter T. Bronson, Northwestern Univ. Med. School, Chicago, Ill.
Fifteenth annual session: New Royal York Hotel, Toronto, Canada, Dec. 2–6, 1929.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Lowell S. Goin, Wilshire Medical Building, Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.
Next meeting in Evansville, Ind., June, 1929.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Annual meeting, Charlottesville, Va., Oct. 18, 1929.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.

*Secretaries of societies not here listed are requested to send the necessary information to the editor.

Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Third session, Sydney, Sept. 2–7, 1929.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION

Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.

Meets annually.

Continental Europe

BELGIAN SOCIETY OF ROENTGENOLOGY

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RONTGENKUNDE UND STRAHLENFORSCHUNG)

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY

Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.

Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN

Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY

Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK

Secretary, Dr. O. Wissing, Copenhagen

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND

Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

PRELIMINARY PROGRAM AMERICAN ROENTGEN RAY SOCIETY

The President Elect, Dr. H. M. Imboden, announces the following as the preliminary program of the Thirtieth Annual Meeting of the American Roentgen Ray Society which will be held at the Hotel Pennsylvania, New York City,

September 17–20, 1929. The Caldwell Lecture, the subject of which is "The Teaching of Roentgenology" will be delivered by Dr. Frederick H. Baetjer of Baltimore.

Xanthomatosis ("Defects in Membranous Bones Exophthalmos and Diabetes Insipidus"). M. C. Sosman, M.D. Boston, Mass.

Indirect Signs of Brain Tumor as Noted in Routine Roentgen-ray Examinations. (A survey of 3,000 Consecutive Skull Examinations.) A. Intracranial Pressure. B. Displacement of Pineal Shadow. C. G. Dyke, M.D. W. F. Schreiber, M.D. Boston, Mass.

Hemolytic Anemias. E. C. Vogt, M.D. L. K. Diamond, M.D. Boston, Mass.

Experimental Acromegaly. Tracy J. Putnam, M.D. Boston, Mass.

Value of the Roentgen Ray in Examinations of Accessory Nasal Sinuses. George Grier, M.D. Pittsburgh, Pa.

Calcifications in the Skull and their Roentgenologic Significance. John D. Camp, M.D. Rochester, Minn.

HEART SYMPOSIUM

Roentgenological and Anatomical Studies on the Aorta. David S. Dann, M.D. Kansas City, Mo.

Standard Left Oblique Study of the Heart and Great Vessels with Tables of Cardiac Area and Valve Measurements. Stafford L. Warren, M.D. Rochester, N. Y.

Roentgenological and Pathological Findings in Some of the Valvular Lesions. David S. Steel, M.D. Cleveland, Ohio.

Luetic Aortitis. Aubrey O. Hampton, M.D. T. Duckett Jones, M.D.

Roentgen-ray Examination of the Heart in Relation to the Clinical Findings. Paul D. White, M.D. Boston, Mass.

Discussion to be opened by Fred. J. Hodges, M.D., Richmond, Va. Howard E. Ruggles, M.D. San Francisco, Calif.

Title of Paper to be Announced later. George Holmes, M.D. Boston, Mass.

Various Types of Metastasis of the Lungs. P. M. Hickey, M.D. Ann Arbor, Mich.

Interlobar Effusions. Isaac Gerber, M.D. Providence, R. I.

Tuberculous Mediastinitis Karl Kornblum, M.D. David Cooper, M.D. Philadelphia, Pa.

Discussion by E. L. Opie, M.D., Philadelphia, Pa.

Intrathoracic Tumors. B. R. Kirklin, M.D. Rochester, Minn.

Clinically Manifest and Latent Tuberculosis. E. L. Opie, M.D. Philadelphia, Pa.

Discussion by Kennon Dunham, M.D. Cincinnati, Ohio.

Deforming Bone Diseases of Adolescence, Alfred L. Gray, M.D. Richmond, Va.

Healing in Congenital Syphilis as Shown by the Roentgen Ray. Stafford McLean, M.D. New York City, N. Y.

Discussion by E. A. Park, M.D., Baltimore, Md.

Diseases of the Upper Respiratory Tract. H. K. Pancoast, M.D. E. P. Pendergrass, M.D. Philadelphia, Pa.

Discussion by Dr. Chevalier Jackson, Philadelphia, Pa.

Roentgenological Diagnosis of Rickets. Ralph S. Bromer, M.D. Philadelphia, Pa.

Myoma of Bone. John T. Murphy, M.D. Toledo, Ohio.

Marble Bones. A. H. Pirie, M.D. Montreal, Canada.

Discussion by A. B. Moore, M.D. Rochester, Minn.

Gastric Retention. A. B. Moore, M.D. Rochester, Minn.

Clinical, Roentgenologic and Operative Findings—Case of Papilloma of the Colon. Wm. H. Stewart, M.D. New York City.

Cecal Stasis. J. L. Kantor, M.D. New York City.

Further Study of Technique of Intravascular Administration of Tetraiodophenolphthalein. Charles Waters, M.D. Baltimore, Md.

Symposium on Value of Roentgen-ray Treatment of Cancer of Breast. R. B. Greenough, M.D. Boston, Mass. Curtis Burnam, Baltimore, Md. Wm. A. Evans, Detroit, Mich.

Discussion—G. E. Pfahler, M.D. Philadelphia, Pa. G. H. Semken, M.D. New York City.

Radiotherapy of Carcinoma of the Breast, Metastatic in Bone. E. T. Leddy, M.D. Rochester, Minn.

Treatment of Exophthalmic Goiter and Hyperthyroidism by Means of Roentgen Rays, with a Statistical Analysis of 500 Cases. G. E. Pfahler, M.D. Jacob Vastine, M.D. Philadelphia, Pa.

Treatment of Angranulocytic Anemia. Fred M. Hodges, M.D. Richmond, Va.

Radiation Therapy in the Treatment of Menstrual Headaches. Charles L. Martin, M.D. Dallas, Texas.

Intraspinal Iodolography. Roentgen Determination of Intraspinal Lesions with the aid of Iodized Oil. Leopold Jaches, M.D. Joseph H. Globus, M.D. New York City, N. Y.

Addresses will also be delivered by Dr. Davis, Professor of Physics, Columbia University, New York City, and Chevalier Jackson, M.D. Philadelphia, Pa. (Title of addresses to be announced.)

Review of Some of the Early Books on Electricity. Edward H. Skinner, M.D. Kansas City, Mo.

Standardization of Development and Calibration of Developer. R. R. Newell, M.D. San Francisco, Calif.

Report of the Committee for the Study and Correlation of Data to be Used in the Standardization of the Technique and Interpretation of Encephalography. Henry Pancoast, M.D. Philadelphia, Pa.

Special Report of the Safety Committee.

The following Clinics will be held on Thursday Morning Sept. 19, and as the accommodations at the various hospitals are limited tickets of admission will be issued and must be secured at the time of registration.

Clinic by Dr. Leopold Jaches and Dr. Coleman B. Rabin on "Correlation of Pathological and Roentgen Findings of Lung Tumors" will be given at the Mount Sinai Hospital.

Clinic dealing with "Diagnosis and Therapy of Malignant Disease" will be given by the Staff of the Memorial Hospital.

The New Medical Center invites the members of the Society and its guests to visit it. The roentgen department will be open for inspection and clinics will be given by various members of the hospital staff on subjects pertaining to the value of roentgen diagnosis.

Dr. Lewis G. Cole will demonstrate at the Fifth Avenue Hospital a new moving picture apparatus which is especially adapted for examinations of the gastro-intestinal tract.

CONCERNING ROENTGEN-RAY FILMS

In a recent report by the National Board of Fire Underwriters and the Ohio

Inspection Bureau* the following extract on the "Nature and Action of Gases from Decomposing Films" may be of interest to roentgenologists:

"The products of decomposition [of nitrocellulose films] vary under different conditions of temperatures and pressures; no one can say definitely just what gases were formed by the decomposition of the films under the conditions prevailing in the film storage room at the time. The following elements were all present in combination: carbon, oxygen, nitrogen, and hydrogen. From the results it is evident that the gases formed in the building included various combinations of these elements, the oxides of nitrogen and of carbon, and probably free hydrogen, as well as unstable compounds of all these elements.

"The oxides of carbon would be the monoxide and dioxide. The latter is harmless but the carbon monoxide is a lethal gas as well as being inflammable and explosive. Approximately 30 per cent of the gases were carbon monoxide which contributed to the destruction of life as well as property.

"Of the oxides of nitrogen it is probable that nitrogen peroxide was the only one present in any quantity. Nitrous oxide, if formed, would have no serious effect and probably would break down at the temperatures existing into its elements of nitrogen and oxygen. Nitric oxide, if formed, would be converted at once to nitrogen peroxide. Nitrogen peroxide probably constituted about 30 per cent of the gases and would cause death because of its corrosive action on the human tissues. In very dilute mixture it will produce headache and illness, and some authorities say that breathing 1 per cent of this gas in air will result in death. When this gas comes in contact with water it dissolves to form nitric acid and nitrous acid together; this is an oxidizing agent and burns the human tissues.

"Although all the elements of hydrogen cyanide were present it is doubtful if the gas itself was formed during the reactions. Possibility of prussic acid, hydrogen cyanide and phosgene being present is remote.

"The hydrogen present in the compounds constituting the original films may have been evolved either as a free gas which burned or exploded or combined with carbon or nitrogen. In any event it undoubtedly added to the combustible and explosive constituents.

"Lack of air in the room prevented free burning of the film, hence a great quantity of gas was formed. The yellowish brown vapors rapidly passed out of the film room into the machine room and through the pipe tunnel up the pipe ducts and through the entire building. The gases must have been heated past their ignition point, hence flashed on contact with air . . ."

The conclusions reached in this report also contain information of value to all persons responsible for storage of roentgen films:

"One of the characteristics of nitrocellulose film is decomposition or flameless combustion at a relatively low temperature, with the evolution of a large volume of gases of a variable chemical composition but known to be harmful from a life standpoint and of such nature that gas explosions may occur. These conditions were borne out by this fire.

"A very important point to be appreciated in such fires is, as noted, the presence of nitrous fumes. Water will absorb a considerable portion of these fumes. The water spray from automatic sprinklers is, as a result, very effective in reducing the possibility of danger from this undesirable feature. While only a small percentage of the other gases are absorbed by water, the water spray cools them below the ignition point and also saturates them with moisture. They therefore will not take fire spontaneously when they issue from vault or room and are more difficult to ignite subsequently, due to their water vapor content.

"Other fires and tests made of this material have proven the danger of explosion from the gases of decomposition, the toxic quality of the fumes and the intense heat when actual burning occurs; an outstanding feature is the rapidity of burning.

" . . . Storage without suitable venting of the room and without automatic sprinklers will always introduce an extreme life hazard, and the probability of considerable damage to the building.

"There are two reasonable methods of assuring proper safeguards. The first is through a compulsory substitution of a type of film which does not have the characteristic of that made of nitrocellulose material. There has been a film of this character on the market for a number of years and in certain territories its use has become very general through recognition by hospital staffs of the more hazardous character of the nitrate film. The second preventative method is the adoption by States or municipalities of stringent requirements covering the storage and handling of the nitrate film. Storage outside the building

* Report on the Cleveland Clinic Fire, Cleveland, Ohio, May 15, 1929, p. 12.

and well removed from other structures is preferable and where this is not possible the regulations of the National Board of Fire Underwriters, which provide for ample vents, automatic sprinkler protection and other safeguards, should be carried out in their entirety. These regulations are also applicable to and should be made to cover the storage and handling of similar film in portrait and commercial studios and in doctors' offices . ."

WARNING—FIRE EXTINGUISHERS!

To the Editor:

It has come to my attention that the use of small hand-pump extinguishers on film fires may result in the formation of phosgene ($COCl_2$) in poisonous quantities. The danger seems to be due to carbon tetrachloride which in contact with heated iron or metals, or with an actual fire, produces phosgene. This has been confirmed experimentally, and the details may be found in an article by Fieldner, Katz, Kinney and Longfellow in the *Journal of the Franklin Institute*, 1920, vol. 190, page 543. These authors report several fatal accidents from the use of carbon tetrachloride extinguishers in small rooms, and a non-fatal one in the open where an automobile fan drove the products of combustion into the patient's face.

This applies only to the small hand-pump type of fire extinguisher containing carbon tetrachloride. The carbon dioxide type is apparently quite safe, but the best and quickest results have been obtained experimentally by automatic sprinklers.

M. C. SOSMAN.

Vol. XXII, No. 1

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

AN INTRODUCER FOR LIPIODOL IN LUNG MAPPING

BY M. C. MYERSON, M.D.

NEW YORK CITY

THE feasibility and the safety of introducing various substances into the tracheobronchial tree for therapeutic and roentgenographic purposes has been recognized for a long time. The introduction of medicaments into the lower respiratory tract for the treatment of diseased conditions antedates the use of opaque substances for roentgen-ray purposes. In 1850 Horace Green was treating patients in this manner. Jackson first employed bismuth powder through the bronchoscope for mapping the bronchial tree in 1905. Later Lynah and Stewart used bismuth in oil for mapping abscess cavities, and at about the same time Bullowa and Gottlieb mapped the bronchial trees of dogs with a bismuth and oil mixture in the course of their experimental work which demonstrated a peristaltic wave. Since the introduction of lipiodol by Sicard, Forestier, Leroux, Sergent, Cottenot, and others, the practice of bronchography has come to have a recognized place in the diagnosis of many chest conditions.

Fig. 1. Double abscess cavity of right upper lobe in girl aged eighteen, eight years after tonsillectomy. These cavities were not demonstrable without lipiodol.

Fig. 2. Multiple bronchiectatic cavities right lower lobe.

When lipiodol was first introduced, the French workers used the intercricothyroid method of approach to the respiratory tract. Then different clinics began introducing the lipiodol through the bronchoscope. Jackson, Tucker and Clerf, Ballon, and Yankauer were the proponents of this method. Others, principally Pritchard, have used laryngeal syringes and cannulas of special design. Mandelbaum used a special cannula very much like the Mosher "life saver" for his work. Kramer uses

this instrument for lung mapping. Iglauer took advantage of the laryngeal intubation tube and has used this instrument for introducing lipiodol, with considerable success. More recently Ochsner and Nesbit have demonstrated what they call the "passive method" of introducing lipiodol into the tracheobronchial tree. Their technique consists in having the patient aspirate lipiodol shortly after the pharyngeal structures have been anesthetized. Soft rubber catheters are being used by several workers (Sgalitzer, Singer, Mandelbaum). Their methods of introducing the catheter vary somewhat.

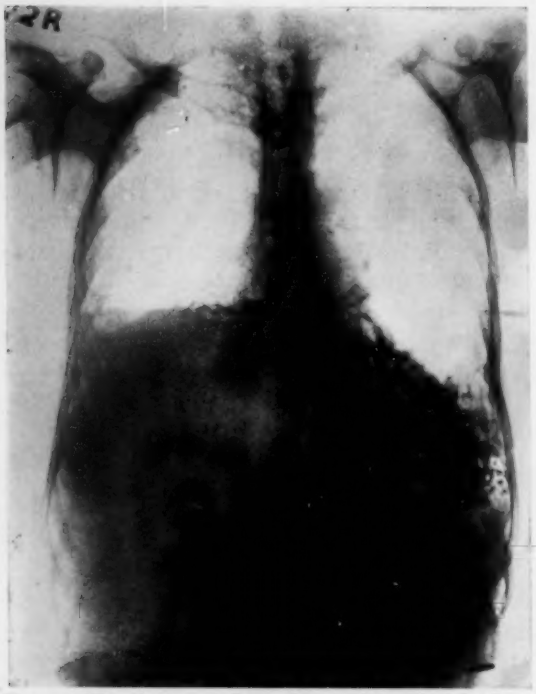

FIG. 3. Showing complete obstruction of right lower lobe bronchus by carcinoma in a female aged fifty-three. Fluid is also present in the pleural cavity.

I have been using a semiflexible tracheal catheter, known as the DeLee catheter, to the distal end of which is attached a metal bulb. The catheter slides readily over a stylet which ends in a slender handle and has a typical laryngeal curve. After the larynx is cocainized the instrument is introduced through the vocal cords and the stylet is withdrawn. This leaves the catheter in the trachea with its proximal end protruding from the mouth. The patient is now told to close his jaws gently upon the catheter and he is permitted to walk about if necessary. He is now sent into the roentgenoscopic room.

FIG. 4. Demonstrating the presence of bronchiectasis behind the heart.

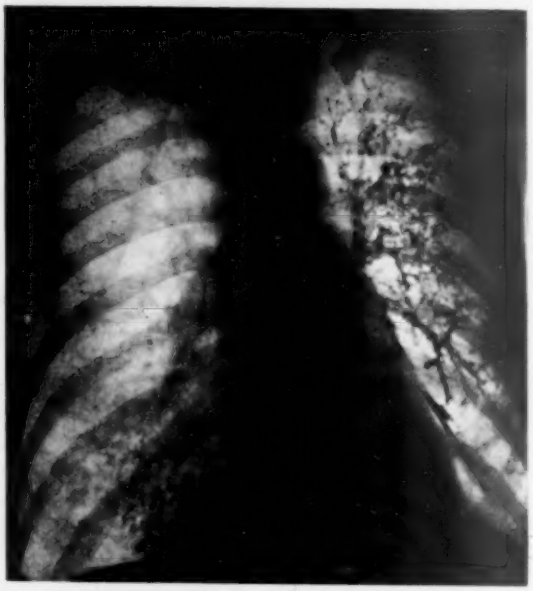

FIG. 5. Demonstrating the patency of the left upper lobe bronchus after the removal of an obstructing fibrolipoma.

The catheter being semiflexible is borne without discomfort and without restricting the movements of the patient's head and neck. The patient is now placed behind

the roentgenoscopic screen and the lipiodol or bismuth in oil mixture is slowly introduced by means of a Luer syringe while the roentgenologist watches the chest. Before the introduction of the opaque substance a few drops of cocain solution are introduced into the trachea through the catheter so that the lower trachea and bronchi are more tolerant.

When it is desired to map the lower lobe of one side, the patient sits or stands behind the roentgenoscopic screen and the opaque substance is introduced with the chest tilted slightly towards the side which we wish to map. If the right lower lobe is being mapped the chest being tilted to the right side will cause the lipiodol or bismuth mixture to come in contact with the right tracheal wall and then work its way down into the right bronchus. An extreme tilting of the chest to a right angle, which really means lying upon the right side, will cause the mixture to flow into the right upper lobe bronchus. For mapping the upper lobe the patient is placed upon a table with the side to be mapped upon the table. Lying upon the left side will insure mapping of the left upper lobe, while lying upon the right side will cause the lipiodol to find its way into the right upper lobe.

This method of introduction of lipiodol has the advantage of simplicity together with the fact that the patient's breathing and comfort are not interfered with. There is no restriction of motion of the head and neck which rigid cannulas and intubation tubes necessitate. The results are satisfactory.

Some illustrations are shown to demonstrate bronchography by the above method.

A HEAD-HOLDING DEVICE FOR THE EXAMINATION OF THE CERVICAL SPINE

BY G. E. PFAHLER, M.D.

PHILADELPHIA, PENNSYLVANIA

IT has been difficult to make a satisfactory study of the cervical spine, especially of the sixth and seventh cervical vertebrae. The Potter-Bucky diaphragm is unsatisfactory for this, and especially for the lateral and oblique positions, the shoulders are in the way. The difficulty is overcome by teleroentgenograms at a distance of 48 inches. The patient is examined in the upright posture, with the shoulder resting against the plate. The cassette is held in any of the upright frames, attached to the examining table. The head can be supported by an adjustable head holder, fixed by a ball and socket joint, which is attached to the top arm of the cassette-holding frame. The whole adjustment is controlled by one thumb screw and the entire construction is shown in Figure 1. A head band or a bandage can be used to fix the head firmly to this holder. It has been useful to us during the past year and may be helpful to others.

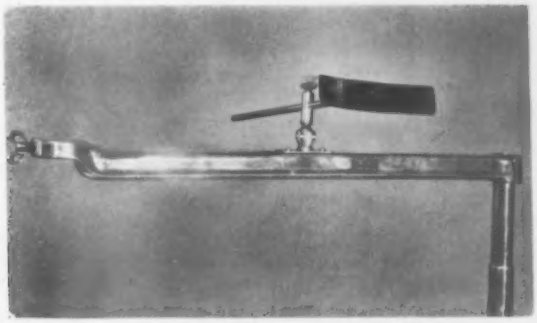

FIG. 1.

A CARRIER FOR RADIUM PACKS AND MOLDS

BY G. E. PFAHLER, M.D.

PHILADELPHIA, PENNSYLVANIA

RADIUM packs and wax molds covered with radium are being used more and more in the treatment of malignant disease. The carrying of these molds from one place to another is a serious matter, for they usually involve relatively large quantities of radium and they are often bulky. I have seen nothing published that is entirely satisfactory for this purpose. We have therefore built a carrier that I believe will meet requirements.

It consists of a box, size 10½″ × 10½″ × 13″ outside measurements. The back of this box is 2 ft. high and has a handle at the top (see Fig. 1), which permits the radium to be carried down near the floor which is the farthest point from the general body mass and from the essential organs. The back of the box is covered with ¼ inch of lead, which gives reasonable protection to the person who is carrying it.

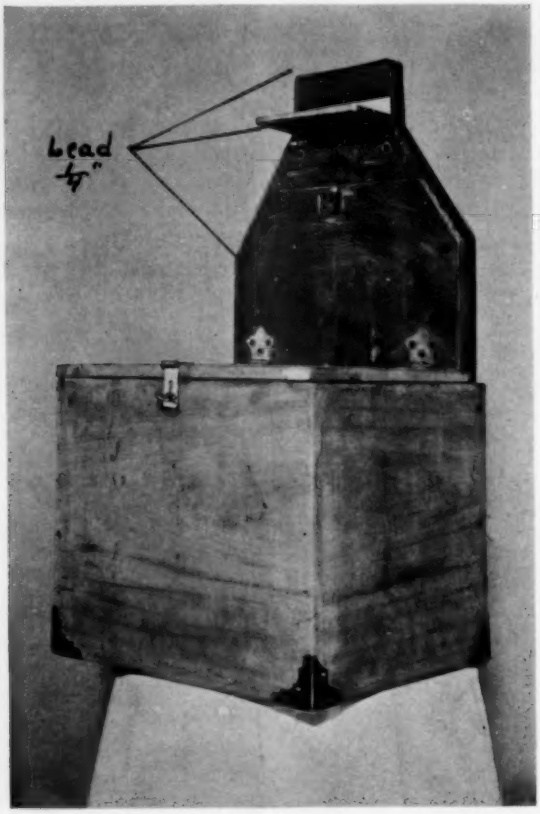

FIG. 1.

This will accommodate any size pack in use today. Unfortunately, the whole box with lead protection weighs 26 pounds, but it is usually only necessary to carry it either to an elevator, or to an automobile or taxicab. A much more compact box could be used but this would necessitate the distribution of the radium after reaching the patient, thus involving unnecessary exposure. It is always safer and better to prepare these packs in the laboratory where protection is available.

The general construction of the box is easily recognized by the illustration.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Aisenberg, M. F. Calcinosis interstitialis universalis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1929, xxxix, 443–447.

A case of generalized interstitial calcinosis is described in a child six years of age, the case being illustrated with numerous roentgenograms. In connection with this, the author expresses the opinion that the progressive calcium deposition in the interstitial tissues must be the result of inner secretoric disturbances (chiefly parathyroids). The balance between assimilation and dissimilation of the calcium being disturbed, calcium deposit in the interstitial tissues results. The condition is rapidly progressive. In the author's case electroionic therapy led to a temporary improvement of four months' duration.—*T. Leucutia.*

Armand-Delille, P.-F., Lestocquoy, Ch., and Vibert, J. A method of anatomical control of pulmonary roentgenograms. *Presse méd.*, April 17, 1929, xxxvii, 504–507.

The importance of comparing roentgenograms with anatomico-pathological specimens for a more precise study of the roentgenologic appearance of pulmonary lesions is evident. In order to preserve the life-like conditions of the lungs as much as possible, the authors devised a method by which the fixation and hardening of the anatomical specimens is performed with the least distortion.

The procedure consists in the making of molds of different sizes and placing the intrathoracic structures, which at autopsy are removed in toto, within the molds, the lower aperture of the molds being fastened with large bands of gauze so as to keep the organs in proper position. The molds containing the anatomical structures are then placed in a 10 per cent formol solution for a period of fifteen days until complete hardening is obtained. After the lapse of fifteen days the hardened structures are removed from the molds and horizontal sections of 0.5 cm. thickness are made. Since formol produces discoloration, the sections are placed for a period of two days in 90 per cent alcohol, which reëstablishes the normal color. Finally the sections are placed in Kaiserling solution No. 2 or in Kaiser's mixture. The sections so prepared can easily be compared with the roentgenograms which were taken shortly before death.

The advantages of such a procedure are: (1) that very early tuberculous lesions of the lungs can be detected even in cases with entirely negative roentgen findings; (2) that lesions are often found to be more extensive and of a more generalized nature than could be suspected from the roentgenograms; (3) that a differentiation is possible between perihilar and juxtahilar shadows, and (4) that the roentgenologically invisible zones can also be investigated, this applying especially to the inner half of the left posterior phrenocostal sinus which is covered by the heart shadow and to the lower posterior portion of the bases of the lungs which are covered by the diaphragmatic dome.—*T. Leucutia.*

Baensch, W. Roentgen diagnosis of urinary concrements. *Zentralbl. f. Chir.*, April 6, 1929, lvi, 879–882.

Three unusual cases of urinary calculi are presented. In the first case the calculus was in an abnormally high superior calyx giving the impression on the flat roentgenogram as being outside of the kidney area; in the second case the calculi gave the appearance of phleboliths, and in the third case there was a negative calculus. In all cases the injection of the urinary tract by contrast media led to the correct diagnosis. It is recommended that in all cases with indefinite abdominal symptomatology roentgenograms of the urinary tract be taken and that whenever possible these be associated with pyelographic examination.—*T. Leucutia.*

Bernstein, Arnold. Myoma of the duodenal bulb. *Beitr. z. klin. Chir.*, 1929, cxlv, 532–540.

A case of myoma of the duodenal bulb is described in which roentgenograms revealed a filling defect in the region of the bulb with spastic contraction of the greater bulbus curvature. The appearance was that of a carcinoma and only at operation could a correct diagnosis be made.—*T. Leucutia.*

Blum, Robert. Mediastinal hernia due to encapsulated empyema of the pleura. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1929, xxxix, 474–479.

The roentgenograms of a patient sixteen years of age are presented showing an encap-

sulated empyema of the left thorax which gradually extended through the mediastinum to the right chest. Later, the spontaneous rupture of the empyema into the left bronchus led to a partial pyopneumothorax. Following clinical healing a restitutio ad integrum was observed roentgenologically. In connection with this the author discusses the significance of the so-called "thymic niche" which forms a locus minoris resistenciae predisposing to hernia of the mediastinum thus enabling migration of the process from one side of the chest to the other.—*T. Leucutia.*

Bonnamour and Badolle. The roentgenography of the normal lung following the injection of lipiodol and the diagnosis of small bronchial dilatations. *Presse méd.*, Feb. 6, 1929, xxxvii, 173–176.

The author from numerous experiments on cadavers established the typical picture of the normal lung injected by lipiodol and compared this with the picture obtained in living normal individuals. It was found that the application of a uniform technique is essential. Best results were obtained by the injection, following the local anesthesia of the larynx, of 30 c.c. of lipiodol by the laryngeal route. Films were taken at a distance of 90 cm. to 1 meter with a flash exposure of less than one-eighth second. Only one side was injected at a time and the film was taken one-quarter of an hour following the injection.

The picture of an injected normal lung in the living may be compared to a tree in full season, while the injected lung of a cadaver resembles more the picture of a dead tree.

(1) The appearance of foliage without branches indicates an entirely normal lung. This appearance is explained by the fact that immediately following the injection the muscles of the bronchi contract and they expel the oil within the lumen of the bronchi either towards the upper air passages or force it down into the alveoli. This, as a rule, happens within five minutes following the injection.

(2) If the muscles of the bronchi lose their ability to contract, as in cadavers, or in certain pathologieal lesions, the injected oil remains within the lumen of the bronchi and thus the picture resembles that of foliage with intermingling of branches. The inability of the bronchi to contract may be due to immobilization or paresis.

(3) The appearance of a dead tree indicates the presence of small bronchial dilatations. In such instances the injected bronchi terminate rather abruptly like dead branches of a tree. Occasionally, the presence of remaining leaves around the dead branches indicates evidence of small bronchiectatic areas. The exploration of such areas ought to be carried out systematically for the different sections of the lung.—*T. Leucutia.*

Sergent, Emile and Cottenot, Paul. Roentgenography of the normal lung following injection of lipiodol and the diagnosis of small bronchial dilatations. *Presse méd.*, April 13, 1929, xxxvii, 481–482.

The value of the injection of lipiodol in intrapleural or intraparenchymatous cavities and in certain types of bronchial dilatations is beyond doubt. However great circumspection should be used in the interpretation of the roentgenograms in case of smaller bronchial dilatations. The authors criticize the deductions of Bonnamour and Badolle who claim that an appearance simulating the foliage of a tree indicates a normal lung, while the interspersion of the foliage with branches is indicative of rigid bronchi due either to an alteration within the bronchial wall or to lack of thoracic aspiration.

On the basis of previous experiments in cadavers, the authors are convinced that the difference in the two appearances as described by Bonnamour and Badolle is merely a result of the degree of filling of the bronchi due to the manifold distribution of the lipiodol. Since the quantities of the oil reaching the various parts of the lung are different, one may assume that those areas which contain only a small quantity of lipiodol will show a filling of the alveoli in predominence while if the oil is more abundant the bronchi will also fill, thus leading to the aspect of "foliage with interspersion of branches." It is evident that such a condition does not have a pathological significance and that it would indeed be too far fetched to consider the aspect as characteristic of gassed lungs.

The contention of Bonnamour and Badolle that the brusk termination of an opaque bronchus giving the impression as if cut off with scissors indicates a pathological bronchus is also questionable. The authors have seen similar appearances many times as part of normal lung pictures.

The conclusion is therefore reached that the injection of lipiodol may show a generalized or localized dilatation of the bronchi or a change in the architecture of the bronchial tree (whether this is due to peribronchial and bronchopulmonary sclerosis or to the presence of tumors and encysted collections) but that all other signs (images of rigid opaque bronchi, "cut" bronchi, etc.) are without value.—*T. Leucutia.*

Bronner, H. Congenital kinking of the fundus of the gall-bladder; cholecystographic diagnosis and clinical significance. *Beitr. z. klin. Chir.*, 1928, cxlv, 132–142.

Two cases are described in which cholecystography revealed a kinking characterized by an unusual appearance of the shadow of the fundus of the gall-bladder and by a delayed emptying of the gall-bladder following the administration of egg yolk. Roentgenograms are presented. In connection with this the conditions leading to kinking of the gall-bladder are discussed. These may be gallstones (Bartel), unusually long fundus, external influences (compression of the gall-bladder during exposure of films, wearing of corsets), pressure on the gall-bladder during pregnancy. In practically all instances it is easy to differentiate from congenital kinking of the gall-bladder which as a rule is due to an anomalous development (segmentation) of the fundus of the gall-bladder.—*T. Leucutia.*

Campbell, John S. Stereoscopic radiography of the coronary system. *Quart. J. Med.*, Jan., 1929, xxii, 247–267.

Campbell studied the coronary system by injection of the vessels of the heart, using röntyum, a barium preparation, as the opaque medium. A portion of the great vessels was removed intact with each specimen. Standard pressure of 280 mm. of mercury for three minutes was employed. After washing out all blood and all clots, the proximal portion of each coronary artery was exposed, and after injection was ligatured closely to the aorta. The heart was again washed out, the chambers were packed with wool, and the organ was immersed in formalin, 10 per cent solution, for twenty-four hours to secure fixation in the optimum position for stereoscopic examination.

The distribution of the coronary arteries, the blood supply of the aorta, the variations in the ventricular distribution of the coronary arteries, the anastomosis of the interventricular and the interatrial septa, and the blood supply of the neuromuscular tissue are described in great detail. There are certain definite changes in the coronary circulation incident to age and this knowledge is necessary for interpretation; thus the coronary picture of a man aged seventy-five, would, in a man of fifty, be distinctly pathological, constituting premature senility. Stereoscopic roentgenography throws much light on the morbid anatomy of the coronary circulation. Specimens illustrating coronary occlusion due to arteritis or atheroma, thrombosis, and embolism are shown. Infarctions are usually smaller than the area of distribution of the occluded vessel.

Campbell's summary is as follows:

1. From a study of 100 hearts, it may be said that stereoscopic roentgenography is of much value in demonstrating the cardiac lesions which come to autopsy, and can do much to give a clearer conception of the course of those lesions which have a fatal termination.

2. Variations in the anatomical distribution of the coronary vessels are very frequent. They have a definite bearing on the clinical aspects of coronary disease.

3. The age changes and anastomoses described by Gross have been verified.

4. Anastomoses fulfil a function in preserving the cardiac muscle, which increases in importance in cases of coronary disease.

5. The neuromuscular tissue is specially safeguarded by many alternative channels of supply.

6. Coronary disease is relatively common though often quite unsuspected.

7. Within very considerable limits, the heart is able to adapt itself to even marked alterations in the lumen of its vessels or the sources of its supply, provided the lesion is not too sudden in onset or too extensive in degree.—*R. S. Bromer.*

Cushway, B. C., and Maier, R. J. Routine examination of the spine for industrial employes. *J. Am. M. Ass.* March 2, 1929, xcii, 701–705.

This paper presents the results of the studies undertaken with the idea of determining the percentage of anomalies present in a given series of patients in order to establish a standard.

Very few variations were found in the cervical and thoracic vertebrae, the greater percentage occurring in the lumbar and sacral region and especially at the lumbosacral joint.

Nine hundred and thirty-one men with symptomless spines were examined; of these, 414 had a total of 510 anomalies and abnormalities, some of which were as follows:

Spina bifida occulta occurred in 161 cases.
Supernumerary ribs occurred in 84 cases.
Sacralization of the transverse process of the fifth lumbar occurred in 50 cases.
Supernumerary or complete absence of vertebra occurred in 46 cases.

The other anomalies occurred with less frequency. Of these potentially weak backs, not one of the men has lost a day's work, in fact the authors are not convinced that these backs are potentially weak, and they recommend an examination of the lungs and

spine of every employee before he begins to work.—*E. P. Pendergrass.*

Dittrich, Rufolf. On regressive changes of the bone. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1929, xxxix, 421–428.

The author describes a case in a man twenty-nine and a half years of age who for a period of ten years suffered from a moderate tuberculosis of the lung and who at the time of the examination presented a peculiar discoloration of the nails of the fingers with slight swelling. Roentgenograms revealed areas of rarefaction of the terminal phalanges. A roentgenogram of the skull revealed an abnormally small sella.

It is possible that the condition represents an atypical osteitis tuberculosa multiplex cystica (Jüngling). However, because of the changes of the sella a condition due to endocrine disturbance cannot be eliminated. The influence of the pituitary gland on bone hypertrophy in acromegaly is well known. It is possible that the regressive changes observed in this instance may be due to a hyperfunction of the pituitary gland. A definite diagnosis will be made after further observation.—*T. Leucutia.*

Ernst, Georg. Calcifications of the cartilages of the ribs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1929, xxxix, 485–494.

On the basis of over 2000 roentgenograms calcifications of the costal cartilages were placed in three main groups (according to their extension): (1) beginning calcification of the first rib and of the cartilages of the succeeding ribs—178 cases; (2) moderate calcification of the first rib and of the cartilages of the succeeding ribs—984 cases; (3) extensive calcification of the first rib and of the cartilages of all other ribs—419 cases. One hundred and forty-nine cases showed no calcification.

It was observed that the calcification always starts with the first rib and that it gradually extends to the cartilage of the other ribs. The incidence of calcification of the cartilages of the ribs was studied with regard to (*a*) age, (*b*) sex, (*c*) occupation and (*d*) different pathological conditions. (*a*) Beginning calcification is observed between the ages of twenty and twenty-five; moderate calcifications between twenty-five and forty-five and extensive calcification between forty-five and fifty-five. (*b*) Of 1581 cases 1161 were males and 420 females. (*c*) The calcifications were observed most frequently in individuals doing heavy manual labor (1376 cases) while only 205 cases otherwise employed showed calcification. (*d*) In 51 per cent of the cases calcification was associated with diseases of the respiratory organs, in 16 per cent with circulatory diseases and in 4 per cent with disturbances of internal secretion. The rest (12 per cent) showed metabolic changes, etc.

In analyzing the 474 cases associated with tuberculosis of the lungs, 194 were found to be active and 280 inactive. The following percentages were obtained in the different grades of calcification: (1) beginning calcification, 23 per cent active and 13 per cent inactive; (2) moderate calcification, 59 per cent active and 62 per cent inactive; (3) extensive calcification, 18 per cent active and 25 per cent inactive. This indicates that the activity of the tuberculosis has no association with the degree of calcium deposit. Of the diseases of the circulatory system arteriosclerosis was observed most frequently.

The calcification of the cartilages of the ribs is a biological process due to degeneration of the cartilages through use. Consequently it is a manifestation occurring with progressing age and can be considered as pathological only in the cases in which it occurs early. The dysfunction of breathing such as respiratory insufficiency (Hofbauer) plays a great part in the production of the early calcifications.—*T. Leucutia.*

Fedder, Ludwig. The roentgen diagnosis of chronic appendicitis. *Beitr. z. klin. Chir.*, 1928, cxlv, 342–378.

After discussing the embryology and the physiologic function of the normal appendix the author, on the basis of a series of 46 operated cases (the roentgen examination being positive in 50 per cent of the cases examined), gives the following roentgen signs as more or less characteristic: (*a*) Length. The average length of the appendix is 8.6 cm. However, appendices as long as 15 cm. are not rare occurrences. An unusually long appendix is more apt to be pathological because of the increased difficulty of emptying. On the other hand, very short appendices indicate that only the proximal part has filled, there being an obstruction of the distant portion (atresia, stenosis, kinking, hydrops, empyema, abscess, etc.). The author therefore considers both extremes of the length of the appendix as more or less pathological.

(*b*) Position. The normal appendix, as proven by Treves, may show three varieties of its position: (1) the fetal form, the appendix appearing as a funnel-shaped continuation of the cecum; (2) the appendix sitting on the broad base of the cecum, and (3) the appendix originating from the posterior aspect of the cecum just behind the ileocecal valve. A

dextrolateral position always indicates a highly pathological appendix.

(*c*) Form. The changes in form are the result of the anatomico-pathological condition of the appendix. Three forms of chronic appendicitis are described: (1) the granulating form, (2) the lymphoid form and (3) the chronic atrophic form. Of these three forms only the granulating and the chronic atrophic forms are important roentgenologically. In the granulating form the appendicial shadow appears very thin, occasionally showing constrictions of different size, while in the chronic atrophic form the lumen of the appendix is maintained and constrictions are rare.

(*d*) Adhesions. The fixation of the appendix with frequent occurrence of kinkings is characteristic of chronic adhesive appendicitis.

(*e*) Emptying. A partial filling of the appendix persisting for a period of several days always indicates a pathological condition.

(*f*) Segmentation of the Contrast Shadow. The segmentation or fragmentation of the contrast shadow is produced by haustrations such as observed in the colon or by food particles entering the appendix.

(*g*) Sensitiveness on Palpation. The symptom of sensitiveness of the appendix on pressure should be considered carefully and should be used only in conjunction with other symptoms.

(*b*) Attention is drawn to the fact that a chronic appendicitis is often associated with symptoms of the neighboring organs such as cecum (stasis, spasm of the ileocecal sphincter), duodenum and stomach (Poenaru Caplesco finding in 14 per cent of over 2000 appendectomies the typical symptoms of gastric ulcers). *T. Leucutia.*

Gloor, Walther. Contribution to differential diagnosis of miliary tuberculosis and miliary carcinosis of the lung. *Schweizer. med. Wchnschr.*, Feb. 16, 1929, lix, 151–154.

A case of miliary carcinosis of the lungs is described in a man aged forty-six, where a mistaken diagnosis of miliary tuberculosis was made. In connection with this the author insists especially upon the roentgen appearance of the two conditions, in miliary tuberculosis there being also involvement of the apices while in miliary carcinosis the lesion is confined mostly to the bases and middle fields of the lungs. In the case mentioned there was evidence of tubercle bacilli and the Besredka reaction was positive, indicating that the miliary carcinosis was complicated by an apical tuberculosis.

The elevation of temperature which is present in miliary tuberculosis cannot always be used as a sign of differentiation from miliary carcinosis. The author refers to 2 cases of miliary tuberculosis which he observed previously and which have healed, this indicating that the elevation of temperature which is observed in acute cases may be often lacking in the chronic cases or in healed cases of miliary tuberculosis. The same thing may be said concerning the lymphocytosis which occasionally is entirely lacking.

The conclusion is reached that a differential diagnosis between miliary tuberculosis and miliary carcinosis in rare instances is impossible.—*T. Leucutia.*

Hawes, John B. 2d, and Friedman, Eli. Interpretation of roentgenograms in tracheobronchial gland tuberculosis. *J. Am. M. Ass.*, Feb. 23, 1929, xcii, 609–610.

The authors made roentgenographic examinations of 109 children between the ages of seven and twelve years. All were contact cases with sputum positive tuberculous patients and each child had a positive skin tuberculin reaction. The startling revelation of this study was the discrepancy in the interpretation of the roentgenograms. There were 29 cases considered positive for tracheobronchial tuberculosis. The following table illustrates the variation in the interpretation.

ANALYSIS OF 29 POSITIVE CASES

	Roentgenograms	Clinical
Considered positive by all 6 observers	0	0
Considered positive by 5 observers	1	1
Considered positive by 4 observers	1	1
Considered positive by 3 observers	6	6
Considered positive by 2 observers	6	6
Considered positive by 1 observer. . .	13	15

Their conclusions are: Hilum tuberculosis cannot be diagnosed by the roentgenogram alone; enlarged tracheobronchial glands do not necessarily mean active tuberculosis; calcification in the nodes is evidence of healing or a healed process; the value of the roentgenogram in diagnosis of tracheobroncheal tuberculosis is questionable.—*E. P. Pendergrass.*

Holland, C. Thurstan. A radiographical note on injuries to the distal epiphyses of the radius and ulna. *Proc. Roy. Soc. Med.*, March, 1929, xxii, 695–700.

The author points out two "elementary facts" to be remembered in making roentgen examinations of the bones of children: (1) Cartilaginous epiphyses are not shown by roentgen rays. (2) It is only when the centers of ossification are present that any shadow can be shown and then it is merely the central opaque portion of a much larger structure consisting of cartilage.

Attention is called to the varying times at which the ossification centers may appear. He states that the radial epiphysis may begin to ossify normally as early as the sixth month or as late as the end of the second year. The ulnar epiphysis ossifies much later, from the fourth to the seventh year.

Injuries were demonstrated in 95 out of a total of 10,991 cases examined. Of these the injury was a backward displacement of the radial epiphysis in 68 males and 25 females and a forward displacement in one male and one female. Both epiphyses were displaced backward in one male and one female.

Anteroposterior views are of little or no value even if stereoscopic. Lateral views alone will justify a diagnosis and show the amount of displacement. Backward displacement of the radial epiphysis is caused by exactly the same kind of trauma as Colles' fracture. The author believes that true Colles' fracture is rare under twenty years of age. A definitely displaced radial epiphysis without the addition of some damage to the diaphysis is extremely rare. There is usually a diaphyseal tear on the side toward which the epiphysis is displaced. This finding is diagnostic without actual displacement of the epiphyses at the time of examination. A few weeks after injury roentgenograms may show a periosteal bone deposit at this site due to repair following the stripping off of the periosteum.—*P. A. Bisbop.*

ILLIG, WERNER. The vena azygos lobe in the roentgenogram. *Fortscbr. a. d. Geb. d. Röntgenstrablen*, March, 1929, xxxix, 428–432.

Twelve cases of azygos lobe are described and in connection with this the usual appearance of the roentgenogram in such instances is discussed.—*T. Leucutia.*

ISRAELSKI, MARTIN. Multiple mottling of the stomach in the roentgenogram due to food residue. *Fortscbr. a. d. Geb. d. Rontgenstrablen*, March, 1929, xxxix, 472–473.

The author describes a case of mottling of the upper portion of the barium-filled stomach in a patient fifty-four years of age suffering from a carcinoma of the pyloric end. At the time of the examination no interpretation could be given of this mottling. Several lavages failed to change the appearance of the mottling. An operation done a few days later revealed an enormously enlarged stomach with a carcinoma of the pyloric end. A resection of the pyloric end was performed. However nothing was found to explain the mottled appearance of the upper portion of the stomach. Shortly following the operation the patient vomited undigested mushrooms.

In reëxamining the case, the mottled appearance of the stomach had disappeared. The view is expressed that the mushrooms, which had been in the stomach for a period of about eight days, produced the mottled appearance but that this was not found at the time of the operation since the mushrooms migrated towards the fundus of the stomach. Attention is called to the fact that undigested food may remain in the stomach for a long period thus simulating filling defects in roentgenograms.—*T. Leucutia.*

KANZOW. Case reports on diseases of the esophagus. *Fortscbr. a. d. Geb. d. Röntgenstrablen*, March, 1929, xxxix, 447–450.

Two cases of esophageal spasm with enormous dilatation of the esophagus are described, one in a man without definite etiology of the spasm and a second in a woman suffering from a gall-bladder condition. The second case was treated by atropine and papaverine injections and a temporary improvement was obtained.—*T. Leucutia.*

KÄSTNER, H. Osteitis fibrosa. *Zentralbl. f. Cbir.*, April 6, 1929, lvi, 862–867.

A case of localized osteitis fibrosa is described in the left humerus of a boy aged thirteen. Following grafting of a piece of tibia within the destroyed area there was good healing. The roentgenograms preliminary to and following the operation are presented. The influence of trauma on osteitis fibrosa as well as the operative procedure is briefly discussed. The opinion is expressed that 2 per cent of the cases of osteitis fibrosa finally suffer sarcomatous degeneration.—*T. Leucutia.*

LUNDSGAARD, C., and RUD, E. Roentgenologic demonstration of peripheral arteriosclerosis and its clinical significance. *Ztscbr. f. klin. Med.*, 1928, cix, 502–522.

The diagnosis of arteriosclerosis and its relation to certain diseases (of heart, kidney, brain, etc.) belong to the most difficult problems. As a rule, criteria of a more or less general character such as the age of the patient, occupation, the inspection and palpation of certain superficial arteries (art. temporalis and radialis, etc.) are taken into consideration and the diagnosis is made on the coincidence of several of these criteria. The authors undertook to investigate whether or not the roentgenologic demonstration of calcification of the peripheral arteries would enable a more definite diagnosis.

Three hundred and forty-five patients (193 men and 152 women) were examined roentgenologically with regard to arteriosclerosis of the peripheral arteries. All patients were suffering from conditions which are known to be associated with arteriosclerosis such as essential hypertension, chronic nephritis, nephrosclerosis, angina pectoris, coronary sclerosis, myocardial degeneration, lesions of the aorta, cerebral apoplexy, etc. In addition to roentgenograms of the leg and forearm (the examination always being carried out on the right extremities), a roentgenogram of the heart was taken and the blood pressure was measured. In 151 cases ophthalmoscopic examinations were also done in order to ascertain the condition of the retinal vessels.

It was found that the peripheral arteriosclerosis occurs more frequently in men (50 per cent of the examined cases) than in women (10 per cent of the examined cases). The blood vessel chiefly affected was the art. tibialispostica. In about half of the cases arteriosclerosis of the peripheral vessels was detected without the palpation revealing a pathological condition of the art. radialis and temporalis. The blood pressure was increased in men in 44 per cent and in women in 77 per cent of the cases. At least half of the total cases showed no evidence of increased blood pressure, this indicating that hypertension is not the only cause of arteriosclerosis. Of the 113 positive cases, subjective heart symptoms were observed in 88 and objective symptoms (mostly cases of myocardial degeneration and angina pectoris) in 64 of the cases. In 16 cases there were no clinical symptoms. In 6 of the negative cases coming to post mortem there was evidence of coronary sclerosis.

The roentgenologic arteriosclerosis is of a diagnostic significance: (1) in the demonstration of local calcification of the blood vessels in claudicatio intermittens and similar pain of the extremities without evidence of a generalized lesion (4 such cases being described); (2) in the differentiation of lesions of a more generalized character especially in regard to visualization of the arteriosclerosis as an etiological factor in certain heart conditions; (3) in the differentiation of organic and functional heart lesions in case of indefinite heart symptomatology.

Of 5 cases observed for a period of two years, in 2 cases the roentgenologic arteriosclerosis remained unchanged, in one there was marked extension and in 2 cases in which there was no evidence of arteriosclerosis at the first examination, a marked arteriosclerosis developed five months and one and three-quarters years later.—*T. Leucutia.*

Moniz, Egas. New technique of arterial encephalography; some cases of localization of cerebral tumors. *Presse méd.*, 1928, xxxvi, 689–693.

Arterial encephalography was first tried by injecting sodium iodide into the internal carotid. Later the method was changed and the contrast medium was injected, after preliminary ligation of the external carotid, into the carotis communis.

The procedure at the present time is as follows: A small incision is made on the neck large enough to permit the insertion of a Martin hemostat (a special hemostat constructed for the purpose of arterial encephalography). The external carotid is then clamped off by using an ordinary hemostat, and the common carotid is drawn forward with the aid of a Martin hemostat. After the insertion of the needle into the artery, the Martin hemostat is closed and 4 to 5 c.c. of solution is rapidly injected. During the final part of the injection, a "flash" roentgenogram of the skull is taken. Immediately following the exposure the clamps are released and the operation is terminated. The films are developed while the patient is waiting and in case of unsatisfactory results, the procedure is repeated without inconvenience to the patient.

The solution injected consists of 25 per cent sodium iodide, which must be chemically pure, since impurities may lead to violent reactions. The solution is warmed to 35°C. previous to injection. The quantity injected averages 6 c.c., a larger quantity producing bradycardia, increase of blood pressure and occasionally syncope.

It is advisable to do the injection bilaterally, with a lapse of several days between the injections. Local anesthesia (novocain) is used as a rule, but in few instances, general anesthesia is of greater advantage. The only contraindication to the procedure is advanced arteriosclerosis.

Roentgenographic Technique. It is essential that the films be taken at the end or immediately after the injection. The exposure should not be longer than $\frac{1}{10}$ of a second. Stereoscopic films were tried by using a special apparatus permitting a rapid change of the films and the tube, but the results so far have been unsatisfactory. The diffusion of the injected solution into the blood stream is so rapid that the second film as a rule reveals only a very faint outline of the injected arterial system.

Reactions. In a majority of cases the reaction is very slight. In some instances epileptic convulsions of the homolateral, or less frequently of the bilateral, type may occur, which, however, are of only short duration, the patient rapidly returning to normal. In one case a very severe epileptic attack followed by hemiplegia of the opposite side was observed; in another case, the epileptic attack was followed by hemiplegia and sensory and motor aphasia. In both instances, the condition entirely cleared up within a period of three days. It is probable that these two accidents were the result of impurities in the solution used.

Interpretation of the Arteriograms. The injected arteries on the two sides are compared in order to detect if there are any abnormalities in the distribution of the blood vessels indicating a pathological condition. Seven cases are described in which the arteriograms were of more or less diagnostic value.—*T. Leucutia.*

MONIZ, E., PINTO, A., and LIMA, A. Arterial encephalography in the diagnosis of four cases of cerebral tumors operated upon. *Presse méd.*, April 17, 1929, xxxvii, 500–504.

Four additional cases of brain tumor are described in which arterial encephalography was of definite value in establishing a correct diagnosis. The method employed was that previously described (see above abstract). In all cases the injection was made bilaterally (at intervals of from two to three weeks) by using 6 to 7.5 c.c. 25 per cent sodium iodide and by injecting the solution through the common carotid (after temporary ligation of the external carotid).

The diagnosis was made by the unusual appearance of the injected blood vessels on the affected side, the following three signs having been found to be of especial importance: (1) the lack of visualization of certain parts of the arterial system as compared to the normal side; (2) the displacement of certain arterial groups as, for example, the Sylvian group, and (3) the appearance of certain new arteries incidental to a rich vascularization of the tumor. By making use of these signs a definite localization of the tumor was possible in the 4 cases described.

The conclusion is reached that arterial encephalography is of considerable diagnostic aid, leading to an exact localization of the tumor and in some instances permitting certain deductions with regard to the nature of the tumor. The method is entirely innocuous, not one single accident having been observed in a series of 70 cases studied.—*T. Leucutia.*

MÜLLER, WALTHER. The roentgenologic appearance and the clinical significance of the so-called cartilaginous bodies of the spinal column. *Beitr. z. klin. Chir.*, 1928, cxlv, 191–211.

As is known, the intervertebral discs consist of the annulus fibrosus, the nucleus pulposus and the two cartilaginous plates. If an injury occurs to the cartilaginous plates the nucleus pulposus or the annulus fibrosus may continue to grow towards the body of the vertebra thus leading to cartilaginous bodies. According to whether the nucleus pulposus or both the nucleus pulposus and the annulus fibrosus take part in the process a partial or total caving in of the spongiosa of the vertebra may result. The partial form is observed chiefly in the region of the twelfth dorsal to third lumbar vertebrae, while the total form may appear in connection with any of the vertebrae.

Five cases are described in detail and illustrated with roentgenograms. In connection with this the clinical significance of the cartilaginous bodies is discussed. The majority of cases showing multiple appearance of the total caving in of the spongiosa of the vertebrae showed marked clinical symptoms. The author, however, does not think that the severe symptoms are the direct result of the cartilaginous bodies but that they are due to the same inciting cause which led to the production of cartilaginous bodies and which is the marked osteoporosis of the vertebral bodies due to some constitutional disease. Very interesting in this regard are the cartilaginous bodies observed in kyphosis adolescentium where there can be no doubt that osteoporosis plays the major part in the production of the kyphosis.—*T. Leucutia.*

NAEGELI, TH. Roentgen examination of the gall-bladder in pregnancy and in puerperium. *Schweizer. med. Wchnschr.*, March 2, 1929, lix, 267–269.

The form, position and especially the emptying of the gall-bladder were studied by cholecystography during pregnancy and in puerperium.

Of 43 cases examined 23 were primiparas, 5 multiparas and 15 in puerperium (eight to sixteen days after delivery).

It was found that the intensity of the shadow is the same as in other patients, that the position of the gall-bladder is only slightly changed (due to the elevation of the liver) without, however, there being a kinking, and that the form is somewhat broader and sac-like. The emptying of the gall-bladder

was in the majority of the cases (70 per cent) considerably delayed. Instead of the usual emptying within fifty to sixty minutes following the administration of three egg yolks, the gall-bladder emptied within six to eight hours and then only one-half of its contents. The same delayed emptying was observed in the cases in puerperium.

Since a delayed emptying of the gall-bladder may be the cause of gallstones—so frequently observed during pregnancy and in puerperium—it is suggested that drugs acting on the parasympatheticus or hormones stimulating the gall-bladder function (ovarian hormones) be administered during the course and shortly after the termination of pregnancy so as to produce a faster emptying of the gall-bladder. Further experiments on this subject are in progress.—*T. Leucutia.*

Paschoud, H., and Zukschwerdt, L. Errors in cholecystography. *Zentralbl. f. Chir.*, March 9, 1929, lvi, 578–582

Four cases are described in which cholecystography showed evidence of shadows simulating gallstones and in which the operation revealed an entirely normal condition of the gall-bladder. In order to elucidate the source of error in these cases, the authors undertook a number of experiments on dogs by determining the action of the normal bile on the dye-containing bile and by studying the effect of the disturbance in the homogeneity of the two biles on the cholecystogram.

The experiments were carried out as follows: 10 per cent iodotetragnost solution (quantity according to the body weight) was injected intravenously in dogs under ether narcosis (without preliminary administration of morphine) and then roentgenograms of the gall-bladder were taken at different intervals. A roentgenogram taken eight hours following the injection of this iodotetragnost solution revealed good filling of the gall-bladder with medium dense gall-bladder shadow. A second roentgenogram taken twenty-four hours later revealed an intensification of the gall-bladder shadow. At this moment 3 c.c. of fresh bile taken from another dog was injected under ether into the fundus of the gall-bladder (in two places), an equal quantity of dye-containing bile having been previously removed. After double ligature of the common duct near the papilla, roentgenograms were taken within two hours and eight hours following the injection of the normal bile and in both instances areas of translucency were found at the places of injection. A small ring of increased radiovisibility surrounded the translucent areas.

In a second series of experiments normal bile and then dye-containing bile were taken from the same dog and mixed in a test tube. The dye-containing bile because of its higher atomic weight sank to the bottom of the test tube producing a lighter ring at the junction of the mixture of the two biles. Simultaneous determinations of viscosity gave a marked difference in the surface tension of the two biles.

The conclusion is reached that when normal bile enters the dye-containing bile of the gall-bladder, areas of increased transparency may appear within the gall-bladder shadow, which in the fasting dogs may last for a period as long as four days. A small lighter ring usually surrounds the areas of increased transparency.

This indicates that: (1) areas of increased or decreased transparencies may occur within the gall-bladder without there being evidence of gallstones (the visualization of a small lighter ring surrounding these areas being of a special diagnostic importance); (2) the simultaneous administration of the Boyden meal or egg yolks (Bromer) at the time of the intravenous injection of the dye may prevent the occurrence of the above-noted areas. In doubtful cases a repetition of the dye injection is advised.—*T. Leucutia.*

Ruppe, Ch. The roentgenography of leontiasis ossea. *Presse méd.*, April 17, 1929, xxxvii, 508.

On the basis of 5 cases of leontiasis ossea which the author was able to study recently, the conclusion is reached that leontiasis ossea does not represent a separate entity but that it is merely a topographic syndrome of different diseases of unknown etiology.

The roentgenologic appearance of leontiasis ossea consists in bony changes which are either of osteoclastic or osteoblastic character. In the first instance a flaky, cotton-like rarefaction of the bone is observed while in the second instance the bony structures appear very thick and opaque. Of the 5 cases observed, 2 belonged to the first group, 2 to the second and in the fifth there was a coexistence of both.

The roentgenologic diagnosis, as a rule, can be made before there is an appearance of clinical symptoms. Though it is generally recognized that the condition is localized only to the facial bones and to the cranium the author found that the first two cervical vertebrae may also be involved, this indicating that the lesion is of a more generalized character.—*T. Leucutia.*

Schertlein, A. Isolated costovertebral luxation of the first rib. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1929, xxxix, 482–485.

A costovertebral luxation of the first rib is described in a patient thirty years of age, occurring after a forward throw from a motor cycle. The case is described because of its extreme rarity.—*T. Leucutia.*

Schütz, Harry. Contribution to the question of typical disease of the sesamoid bone of the first metatarsal. *Beitr. z. klin. Chir.*, 1928, cxlv, 65–74.

The question of the "typical disease of the sesamoid bone of the first metatarsal" was recently studied in all its details by Müller. First the opinion was advanced that the condition is similar to Köhler's, Schlatter's and Perthes' disease but later, on the basis of histological findings, this opinion was changed and the lesion was classified as an osteopathia juvenilis necroticans.

The author describes in detail a case in a woman twenty-two years of age who suffered extensive pain in the region of the head of the metatarsal for a period of three weeks. Following operative removal of the sesamoid bones the pain was promptly relieved.

The condition is characterized roentgenologically by a division of the sesamoid bone into two or more parts with irregular areas of rarefaction. Since the histological examination in the case mentioned revealed necrosis of the trabeculae as well as of the marrow of the sesamoid bones, Müller's view that the lesion represents a juvenile necrotic osteopathy is endorsed. It is probable that the lesion is the result of chronic trauma on a predisposing base.—*T. Leucutia.*

Schweizer, R. Demonstration of a roentgenogram with open ductus thyreoglossus. *Schweizer. med. Wchnschr.*, March 2, 1929, lix, 250.

A case is described in a man aged twenty-three who suffered from septic angina with hemorrhagic nephritis and abscess of the neck. Following the incision of the abscess a fistula developed which failed to heal. Five weeks later a barium mixture was injected into the fistula in order to determine its course and it was found that there was evidence of an open ductus thyreoglossus. The roentgenogram is presented. The fistula produces so little inconvenience to the patient that he has refused to submit to operation.—*T. Leucutia.*

Siwon, P. The practical significance of chronic bone abscesses (Brodie's abscess). *Beitr. z. klin. Chir.*, 1929, cxlv, 463–483.

Reinberg was able to collect, up to 1927, 216 cases of Brodie's abscess from the entire literature. The author adds 8 new cases of his own. All cases are described in detail and illustrated with roentgenograms.

Differential diagnosis includes the usual form of chronic osteomyelitis, tuberculosis of the bone, syphilis, central bone sarcoma, rheumatism of the joint, metatyphous abscess, localized osteitis fibrosa, metastatic malignancies, echinococcus cyst, etc. The differentiation from tuberculosis and metaphyseal osteomyelitis is often very difficult. A round or oval area of rarefaction with sharp margins near the epiphyseal line without sequestration and secondary joint changes as a rule indicates Brodie's abscess.—*T. Leucutia.*

Skinner, Edward H. Roentgenographic interpretation of functional reduction of fractures. *J. Am. M. Ass.*, March 2, 1929, xcii, 693–694.

The normal anatomic relation of joint surfaces and anatomic landmarks may be plotted with almost geometrical exactness on roentgenograms taken in common standard positions. There are surgical regional axioms that guide the estimation of proper reduction of fractures at the joints, and this paper is a plea that these recognized surgical principles should receive due consideration.

The normal weight-bearing line of the tibia passes directly through and bisects the articulating and opposing portion of the astragalus. To obtain the maximal functional result after fracture of the malleolus or some other fracture around the ankle joint this line must be restored and maintained. This restoration is possible without perfect anatomic reduction.

The normal anatomic relation of the lower end of the radius and ulna show the styloid process of the radius distal to the level of the styloid of the ulna. The articulating surface of the lower end of the radius has a normal slant which shows the dorsal edge distal to the palmar edge. In Colles' fracture and other fractures around the wrist joint these lines are destroyed and they should be restored to obtain the maximal result.

The normal anatomic relation of the lower end of the humerus in the lateral shows that the condyles are anterior to a line dropped through the middle of the shaft of the humerus. In the transverse epicondylar fracture of the humerus, the fragments are usually displaced posteriorly and laterally. They must be restored to a position anterior to the midline of the lower end of the humerus to obtain the maximal functional result. This paper properly stresses the importance of functional

reduction of normal joint relations.—*E. P. Pendergrass.*

Spiller, Ulrich. The occurrence, localization and cause of so-called peripheral arteriosclerosis (sclerosis of the media) and its relation to central arteriosclerosis, on the basis of clinico-roentgenological examinations. *Ztschr. f. klin. Med.*, 1929, cix, 647–677.

The word "arteriosclerosis" as conceived at present includes all regressive changes of the blood vessels. Very recently, due to Hueck's and Munk's investigations there was a tendency to limit, from the pathologico-anatomical standpoint, the term "arteriosclerosis" to the various changes occurring within the walls of the arteries (atheromatosis, hyperplasia of the intima, hyaline degeneration of the arterioles, calcification of the media). Clinically, the division into peripheral and central arteriosclerosis is still maintained without, however, there being an effort to correlate the clinical observations with anatomico-pathological findings. On the basis of numerous investigations, the author is of the opinion that the peripheral arteriosclerosis consists essentially of a calcification of the media and consequently represents a separate clinical entity.

One thousand six hundred and fifteen cases were examined by means of roentgenograms of the extremities (right) in regard to the calcium deposit within the walls of the arteries in patients of various ages and occupations. In 75 (4.7 per cent), of which 64 were men and 11 were women, there was evidence of peripheral arteriosclerosis, proving that the lesion is less frequent than formerly assumed and that it is more predominant in men than in women. The condition occurs especially in old age and first appears on the art. dorsalis pedis (the right side being more often affected).

The calcification of the media of the peripheral arteries is independent of processes of the visceral arteries (sclerosis of the aorta, coronary sclerosis, arteriosclerosis) as well as of other processes (hyperplastic and degenerative changes of the intima) of the peripheral arteries themselves. Consequently the presence of the peripheral arteriosclerosis does not permit a diagnosis of general arteriosclerosis.

In analyzing the etiology of the calcification of the media, the author is of the opinion that local influences, such as overwork of certain arteries (due to various occupations), are without significance. It is more probable that the condition is due to changes in the calcium metabolism similar to the metabolic disturbances observed in diabetes. Indeed, the association of peripheral arteriosclerosis with diabetes mellitus is not uncommon.

The calcification of the media produces in the majority of the cases no clinical symptoms whatsoever. In a few instances a secondary proliferation of the intima resulting in gangrene and dysbasia intermittens is observed.—*T. Leucutia.*

Temesváry, Nikolaus. Hysterosalpingography. *Ztschr. f. Geburtsh. u. Gynäk.*, 1928, xciv, 43–86.

After a very detailed review of the literature dealing with the different contrast media as well as with the various techniques used for their injection in hysterosalpingography, the author describes the value of the method: (1) from the point of view of the study of the physiology of the genital organs, and (2) from the point of view of practical aid in the diagnosis of different pathological conditions. (1) The most important physiological phenomena demonstrated by hysterosalpingography are: the size and shape of the normal uterine cavity in vivo, the contraction of the musculature of the uterus, the partial contraction of the sphincter of the tubal ostium leading to an antiperistaltic movement of the tube, the normal peristalsis of the tube which is from the fimbriated end towards the uterus and finally an antiperistaltic movement due to contraction of the muscles within the tubes themselves. (2) Practical applications: (*a*) contraindications: acute infections of the uterus and adnexa, malignant tumors, suspicious pregnancy and preliminary intrauterine procedures; (*b*) indications: sterility, uterine myoma (differentiation of submucous from interstitial), developmental anomalies, differential diagnosis of various uterine and adnexal tumors and postoperative control of the results of certain tubal operations. A voluminous literature is appended.—*T. Leucutia.*

Thoms, Herbert. A roentgenographic study of placental infarcts. *Am. J. Obst. & Gynec.*, Feb. 1929, xvii, 176–185.

In this study of placentas injected with barium sulphate and then roentgenographed, Thoms was able to see the relation of local circulatory disturbance to the entire placental circulation. The usual microscopic methods were employed to check results of the procedure. The chief interest was directed towards placental circulatory arrest due to infarction, and the measurement of such arrest on a percentage basis.

The solution injected consisted of distilled water, gelatine, barium sulphate and thymol. The entire placenta was first roentgenographed

after being hardened in formalin and then when sufficiently hard was cut into strips 1 cm. in width, which were laid parallel to one another on a sheet of glass. A second roentgenogram was then made of these strips.

The study of 58 placentas showed:

1. Marginal white infarct formation is so common that it may be considered a normal phenomenon of the mature placenta. The amount of circulatory disturbance at the edge of the placenta as a result of such infarcts is so slight as to be negligible.

2. The small white infarcts so frequently seen scattered over the fetal surface are for the most part purely surface affairs in the greater number of cases. Infarcts on the fetal surface, even of wide extension, seldom affect the placenta to any degree. A large area of fetal surface may be involved by a white infarct, yet on cross-section and on roentgenographic examination the circulatory arrest is limited to structures lying 1 or 2 mm. below the fetal surface.

3. No definite relation between infarct formation and the toxemia of pregnancy was noted.

Of 58 placentas, 10, or 17 per cent, were found infarcted to a degree sufficient to actually interfere with placental circulation. In one case 24 per cent of the placental circulation was arrested but there was no evidence of any maternal toxemia, or of any ill effect on the baby. Marginal infarcts and infarcts at the entrance of the cord were frequent.

Vascular changes by this method may be shown to students in a manner not possible with any other demonstration.—*R. S. Bromer.*

Welt, Sara, Rosenthal, Nathan, and Oppenheimer, B. S. Gaucher's splenomegaly with special reference to skeletal changes. *J. Am. M. Ass.*, Feb. 23, 1929, xcii, 637–644.

Gaucher's disease is a rare, congenital familial constitutional disorder, possibly of lipoid metabolism in which complex lipoids fail of complete disintegration and are stored in the reticulum cells of the lymphatic hematopoietic system. The clinical manifestations are great enlargement of the spleen and liver, brownish pigmentation of the skin, wedge-shaped thickening of conjunctiva near the cornea, marked hemorrhagic tendency and characteristic blood changes, especially leucopenia and thrombocytopenia. The gross skeletal changes that occur are also familial.

The pathological lesions are limited to the liver, spleen, lymph nodes and bone marrow in which are found the characteristic large uninuclear or multinuclear cells with a fibrillar cytoplasm. The origin of the Gaucher cell is from the reticulum of the lymphatic hematopoietic system and contains a substance called kerasin described by Lieb and others.

The symptoms of the disease may be silent for a long time and its severity may vary within wide limits. The diagnosis may be established by bone marrow puncture, splenic puncture, splenectomy or by the roentgen examination of the long bones. *A biopsy on the peripheral lymph nodes is of little value.* Splenectomy may be indicated to relieve the anemia, the hemorrhagic diathesis or the burdensome weight of the organ but it cannot be considered curative and it may accelerate skeletal changes.

The authors discuss the lipoid cell hyperplasia of the spleen and the differences between Gaucher's disease and Niemann-Pick's disease and the methods of differentiating these similar conditions.

The gross skeletal changes were first described by Pick in 1922, which were pathological fractures of the long bones, palpable thickening of the bone and apparent deformity of the hips. The patient complains of pain, occasional redness and limitation of motion. A stunted appearance with lack of physical development has been noted. There is a distinct tendency to mental deficiency and the disease occurs preponderantly in the Jewish race.

The authors report 6 additional cases of this disease. In the cases where the spine was involved they state that they can confirm Pick's observation that Gaucher's disease involves the bodies of the vertebrae but does not involve the intervertebral discs.

When the long bones are involved, the line of demarcation between the bone marrow and the spongiosa may no longer be seen, and these areas of rarefaction and condensation give a mottled appearance with expansion of the bone and thinning of the cortex. This may extend to the head and neck of the femur. In one case a coxa vara appearance was found. In 2 cases there was a fusiform widening of the shaft of the femur. This seems to be the earliest and most constant finding, whereas the rarefaction and condensation are later findings. The authors suggest that all cases of splenomegaly of obscure origin should have a roentgen examination. The swelling of the shaft is thought to be due to the gradual growth of Gaucher's tissue, consisting of Gaucher's cells, fibrous transformation, necrosis, hemorrhage and blood extravasation. The bone changes are metabolic in origin and not inflammatory or neoplastic. The osteoporosis of the bones is due to calcium-poor

foci, and the pathological fractures occur at points that are weak, due to the thinning of the cortex. The roentgenographic changes of the bones seem to occur in transverse layers.—*E. P. Pendergrass.*

Wesson, Miley B. Pitfalls in urography. *J. Urol.*, 1928, xx, 355–369.

Attention is called to the fact that an incomplete or bizarre filling of the renal pelvis in pyelograms does not represent a pathological condition. It is advisable to take double pyelograms where not specifically contraindicated. Such a procedure allows a comparison of the two sides, thus eliminating the possibility of errors as regards anomalous developments of the renal pelvis. Any case that will tolerate a bilateral collection of urine is suited for bilateral pyelography. Untoward effects are due to urethral or ureteral irritation with resultant anuria. Two such cases, one fatal, are reported following the passage of the cystoscope and the sound.

Since both the under injection and over injection of the pelvis may lead to diagnostic errors it is important that proper pressure be applied during the injection. The gravity injection with two burettes at a height of 18 to 24 inches produces the most satisfactory results.

In discussing the significance of the bizarre fillings of the renal pelvis the following signs are considered more or less pathognomonic of renal tumor: (1) elongation of calyces; (2) distention or retraction of one or more calyces, or of the whole pelvis; (3) filling defects of the whole pelvis caused by invasion of its lumen; (4) rotation and abnormal position of an otherwise normal pelvis; (5) enlarged kidney shadow; (6) deformity of the ureteropelvic juncture and upper ureter, and (7) overlapping of vertebra by ureter. Three cases of incomplete filling of the renal pelvis are reported which were erroneously diagnosed as tumors (in the first case the incomplete filling being due to organized blood clot, in the second to insufficient gravity pressure, and in the third to blocking of the two eyes of the catheter by the mucosa of the pelvis, the tip of the catheter entering too far into the upper calyx).

Three further cases are described in which stones caused a considerable confusion (in 2 cases the stones being of gall-bladder and in one case of renal origin).

Finally a seventh case is reported in which a carcinoma of the bladder was diagnosed from a filling defect in the cystogram that disappeared under the influence of deep therapy but later recurred.—*T. Leucutia.*

Zukschwerdt, L. A case of pancreatic calculi and pancreatic cyst diagnosed roentgenologically. *Fortschr. a. d. Geb. d. Rontgenstrahlen*, March, 1929, xxxix, 469–471.

A case of pancreatic cyst associated with pancreatic calculi is described in a man forty-six years of age, giving a history of pain in the upper abdomen with repeated attacks of icterus. The distribution of the stones was such that gallstones, kidney stones and calcifications of the mesenteric glands could be easily eliminated. The visualization of the contour of a large tumor in the region of the stones made the diagnosis of pancreatic cyst associated with pancreatic stones probable. Since the patient refused operation diagnosis could not be confirmed.—*T. Leucutia.*

ROENTGEN AND RADIUM THERAPY

Brunner, A. Experiences with lead therapy in carcinoma. *Schweizer. med. Wchnschr.*, March 2, 1929, lix, 253–255.

Twenty-three cases were treated by intravenous injection of colloidal lead using the method of Bell. The collosol lead (0.1 per cent lead and 0.1 per cent mercury in colloidal form) of the Crookes Laboratories in London was applied for this purpose by injecting a dose of 5 to 10 c.c. first and by increasing the dose twice weekly to 20 to 50 c.c. until a total of 400 c.c. (0.4 gm. lead and mercury) was injected. In 8 cases the treatment was interrupted since the injections were poorly supported. In 8 cases there was no result and in 7 cases there was a more or less marked improvement. The 7 cases with improvement are described in detail. It is noteworthy that stomach carcinomas are especially well represented in the group (4 out of the 7 cases improved having been gastric carcinomas). In some instances the injection of lead was combined with roentgen therapy. The impression was gained that the combination of the two methods is of some advantage. No definite conclusions are drawn as yet.—*T. Leucutia.*

Dautwitz, Fritz. On the influence of radium upon glycosuria in the irradiation of carcinoma. *Strahlentherapie*, 1929, xxxii, 105–120.

A case of carcinoma of the uterus associated with diabetes mellitus is described in a woman forty-six years of age. Following four series of irradiations (with radium) there was a very marked improvement in the condition of the

carcinoma and at the same time the diabetes disappeared.

In connection with this the advisability of radiation therapy in conditions complicated with diabetes is discussed and the conclusion is reached that in many instances the application of radiation leads simultaneously to the healing of the concomitant diabetes. The mechanism of the effect of the radiation on the diabetes is not clear. Since in the case mentioned the ovaries were the only organs of internal secretion which were within reach of irradiation it is more probable that the action is through a generalized effect on the organism.—*T. Leucutia.*

Dehler, Hans. Does secondary infection influence the success of irradiation in carcinoma of the uterus? *Strablentherapie*, 1929, xxxi, 691–712.

It is a generally accepted fact that 20 per cent of all operable cases of carcinoma of the uterus undergoing radiation therapy do not respond to the treatment. In order to elucidate the reason for this the author undertook numerous experiments especially as regards the importance of the secondary infection of the carcinoma. Such a procedure was incited also by the clinical observation that the primary mortality after radical operation of carcinomas of the uterus was due in 95 per cent of the cases to septic processes such as ascending peritonitis, generalized sepsis, etc.

In examining the cases of uterine carcinoma by the different laboratory methods it was found that two-thirds of all cases coming for treatment were already infected. The bacterial flora consisted in gram-positive and gram-negative diplococci and rods, colon bacillus, sarcinae, yeast, staphylococci, streptococci, etc. The most important part is played by the streptococci.

Thirty-eight cases of untreated carcinomas of the uterus were examined and in 91 per cent of the cases there was evidence of streptococci. In 25 cases, that is 66 per cent, the streptococci were of the hemolytic type. The virulence of the streptococci was determined by the Ruge-Philipp test and it was found that in 15 (39 per cent) of the 38 cases there was evidence of virulent hemolytic streptococci; in 2 cases virulent nonhemolytic streptococci, while the remaining 10 hemolytic and the rest of the streptococci proved avirulent. The 38 cases (33 cervix, 4 corpus and 1 portio vaginalis) were treated during the years 1924 and 1925 by radiation therapy. Twenty-seven of the 38 cases, that is, 71 per cent, died and 29 per cent became well. Of the 27 cases who died, 21 (78 per cent) showed evidence of hemolytic streptococci previous to the irradiation, 14 of which (52 per cent) were of a virulent character. Of the 11 cases who have remained well, in only 4 cases (37 per cent) was there evidence of hemolytic streptococci, and in only one case (9 per cent) was this of the virulent type. There can be no doubt therefore that the presence of hemolytic streptococci, especially of the virulent type, leads to unfavorable results in the radiation therapy of the carcinoma. In another series of experiments (of 89 cancers) published elsewhere the author determined the effect of the radiation in the healing of the infection and there he found that although there is a temporary increase of the infection immediately following the irradiation (due to inhibition of the immunization processes by the radiation effect), within a few weeks a marked improvement, and with in six weeks a complete sterilization results in a great majority of the cases. It seems, however, that the presence of infection at the time of irradiation renders the carcinoma cells more radioresistant, thus leading to more unfavorable terminal results.

The author advises that every case of carcinoma be examined previous to the institution of treatment by the Ruge-Philipp virulence test. In the presence of hemolytic streptococci all procedures leading to extension of the infection, such as dilatation for the application of radium or even biopsy or curettage, should be avoided. It is best in such instances to try first to clear up the infection by the usual antiseptic methods (alcohol, iodoform, rivanol, yatren, vuzin, arsacetin, glycerin or hypertonic solutions) without, however, resorting to caustics (such as silver nitrate, iodine, etc.). A good method for the clearing up of the infection is the copper ionization, as practised by Seitz and Wintz, preliminary to irradiation. Following irradiation the application of disinfectants should be continued, in the more recalcitrant cases with association of injection of streptococcus vaccines (polyvalent or autogenous vaccines) and antistreptococcus sera. It is evident that such a procedure can be best performed by hospitalizing the patient. The ideal method of treatment would be to keep the patient in an institution from the beginning of treatment to completion of the cure.—*T. Leucutia.*

Finzi, N. S., and Harmer, Douglas. The radium treatment of primary carcinomas of the larynx. *Strablentherapie*, 1929, xxxii, 81–90.

The method used closely resembles that employed at Bayet's Clinic. The incision starts at the center of the hyoid bone and

extends outward and downward along the posterior border of the thyroid cartilage. The thyroid cartilage is exposed, the perichondrium stripped from it and the greater portion of the cartilage then resected making a large window. A number of radium needles are then inserted under the cartilage, great care being taken not to penetrate into the growth or into the larynx. The needles are parallel and are placed vertically, each one touching the next. The greatest care is taken to prevent sepsis. The threads attached to the needles are buried beneath the muscles and the wound is completely closed until the needles are removed from four and a half to eight days later. If the anterior commissure is involved the other side of the larynx is treated in the same way. About 7 mg. of radium element is used if one side only is treated and about 12 mg. if both sides are treated. The filter is 0.5 mm. platinum and the time from four and a half to eight days. In some cases a small dose of heavily filtered roentgen rays has been given two or three days before the operation. The closed wound having been sealed by a collodion dressing, a low tracheotomy is performed to avoid trouble from swelling of the glottis, which may result from the radium treatment: this tracheotomy is usually kept open for about six weeks.

Fifteen cases have been treated:

(1) In 8 of these the growth was confined to one vocal cord and did not involve either the anterior commissure or the arytenoid cartilage. In 6 the growths entirely disappeared and the patients have remained well for periods of from one to three years. In most of the cases the vocal cords have recovered to such an extent that it is impossible to detect on which side the growths were situated. In one case the growth diminished in size, but a stenosis of the glottis resulted and the patient died suddenly eight months later of unknown cause. In the eighth case no real improvement resulted from the treatment.

(2) Five cases were advanced, the disease having crossed the middle line in front and involved the other vocal cord, so that nothing except some form of laryngectomy was available as a surgical procedure. One has remained well for four years; his vocal cords are freely movable and appear normal, but the voice result is not so good as would be expected. In one case the disease in the larynx entirely disappeared but the patient died later from a recurrence in the tracheotomy wound a year after the treatment. Of the other 3 cases, one died during the operation, in one no improvement was noticed and in one there was improvement but later recurrence.

(3) Two inoperable cases in which the disease had extended into the larynx or through the laryngeal cartilages into the neck with enlargement of the cervical glands. In one the growth disappeared and the glands were removed by operation; the larynx remained healthy for two and a half years, but there is now a thickening of the vocal cord, probably due to recurrence. In the other there was very great improvement, but the patient died after fifteen months, probably from mediastinal metastases.

It is claimed that in operable cases the after-results as regards function are superior to surgical operation and, if they prove to be permanent, will probably replace it. In advanced cases there seems no doubt that radium should always be tried before laryngectomy.—*Authors' abstract.*

Gambarow, G. The radiation therapy of myoma of the uterus. *Strahlentherapie*, 1929, xxxii, 121–130.

During the past fourteen years 800 cases of myomas have been treated by the author. As regards the technique employed, the cases are divided into two groups: (1) Irradiation with medium doses according to the method of Krönig (1914 to 1924), a dose of 250 to 400 X per sitting, and three to four sittings having been given at four weeks' intervals. (2) A single irradiation according to Seitz and Wintz (1924 to 1928). Of the 180 cases of the second period which were followed up the results are known in 161 cases. The author obtained: Complete disappearance of the tumor in 105 cases (65.22 per cent); diminution to half of the original size or more, 36 cases (22.36 per cent); only slight diminution, 16 cases (10.56 per cent), and no diminution, 3 cases (1.86 per cent).

The end results in all cases (of both periods) were as follows: amenorrhea was produced in 95.5 per cent; complete disappearance of the tumor, 35 per cent; diminution in the size of the tumor, 55 per cent; no changes, 10 per cent.

The advantages of irradiation are that there is no mortality (which at operation may be from 2 to 4 per cent) and that it can be applied in cases of complication with other diseases (such as cardiovascular, lung, kidney conditions, diabetes, Basedow's disease, severe anemia, etc.). The disadvantage of roentgen therapy is the rather severe character of the climacteric changes produced.

In analyzing the relationship of the time of the irradiation to the intermenstruum the author found that the results are practically the same whether the treatment is given in the

first or the second half of the intermenstruum except for the fact that following irradiation in the first half the amenorrhea occurs somewhat sooner. This observation is in contradiction to the one made by Seitz and Wintz who observed that of 81 cases irradiated in the first half of the intermenstruum, in 95 per cent the amenorrhea was reached immediately while in 79 cases irradiated during the second half of the intermenstruum an immediate amenorrhea was obtained in only 3.8 per cent, 79.7 per cent having had one, 14 per cent two 79.7 per cent having had one, 14 per cent two and 2.5 per cent three additional menstruations.

A temporary castration was attempted in only 5 cases of myoma, with satisfactory results. The following rules may be applied in establishing the indications for treatment of uterine myomata: (1) The submucous myomas with broad bases are not suited for irradiation although the author treated one case which has remained amenorrheic for a period of thirteen months. (2) In case of very large myomas irradiation should be attempted in all instances, a good result being obtained in a case with a myoma even as large as a nine months pregnancy. (3) Severe anemia. Irradiation should be applied in all cases except in the severe bleedings where the life is endangered and where operation is indicated. (4) Age. As a rule only patients above forty or forty-five are treated by irradiation. However in well-selected cases younger patients may also be irradiated. (5) Myomas complicated by chronic inflammatory processes. Irradiation is doubly indicated in these cases since irradiation not only leads to amenorrhea but also relieves the inflammatory condition in a large majority of cases. (6) Radium therapy. The application of radium was tried in only 68 cases. Its chief advantage consists in the rapid cessation of bleeding.—*T. Leucutia.*

Gotthardt, Paul Peter. Roentgen therapy of brain tumors in children. *Strahlentherapie*, 1929, xxxi, 720–734.

Eleven cases of cerebral tumors and 8 cases of cerebellar tumors were treated in children between the ages of three and a half and fourteen and three-fourths years. A marked improvement with prolongation of life was obtained in 3 cases; a temporary improvement in 7 cases; 6 cases remained uninfluenced, one case did not complete the treatment and 2 cases received insufficient treatment. It is advised that all brain tumors in children be irradiated first and only the ones refractory to irradiation be operated upon.—*T. Leucutia.*

Grauer, S. A contribution to the roentgen therapy of ozena. *Strahlentherapie*, 1929, xxxi, 801–805.

Four cases of ozena were treated by applying very mild doses of radiation. Two methods were used: in the first method only one field of entry was applied directly over the nose; in the second method three fields of entry, one directly over the nose and from each side of the face, were used. The dose administered in the one field method was ¾ S.U.D. repeated at eight to ten weeks' intervals, while in the three field method it consisted in ½ S.U.D. respectively, repeated at eight to ten weeks' intervals; 30 cm. skin target distance, 0.36 mm. Zn plus 2 mm. Cu, wave length 0.1 Å. Although no cures were obtained, the improvement in the majority of the cases, especially as regards the annoying fetor, was pronounced, in some instances lasting for a period of over a year.—*T. Leucutia.*

Heidrich, L., Haas, M., and Silberberg, M. On the question of irradiation of the plexus in chronic increased intracranial pressure. *Beitr. z. klin. Chir.*, 1928, cxlv, 285–303.

After a brief review of the literature dealing with the effect of irradiation of the choroid plexus on the reduction of the cerebrospinal fluid, the authors present their own investigations which consist in clinical observations and anatomico-pathological experimentations.

The clinical observations were made by irradiating 8 patients with marked intracranial pressure (different cases of brain tumor) and noting the effect on the headaches, hydrocephalus and amount of cerebrospinal fluid. The irradiations were carried out with penetrating rays, 0.5 mm. Cu and 1 mm. Al as filters, 23 cm. skin target distance, two to three fields of entry, ½ to ¾ S.U.D. over the individual fields. In none of the cases was there observed any improvement in the above symptoms following the irradiation.

The anatomico-pathological experimentations were carried out on animals, chiefly dogs. In a first series of animals, the change in the amount of the cerebrospinal fluid, in a second series the histological changes of the choroid plexus and in a third series the vital staining of the choroid plexus were determined following irradiation (with doses as high as 9 S.U.D.). In none of the experiments were there observed any changes which might be attributed to the effect of the roentgen rays on the choroid plexus leading to a diminishing of the cerebrospinal fluid secretion.

The conclusion is reached that irradiation of the choroid plexus does not result in a

decrease of the intracranial pressure. Since this is contrary to the results of the experiments of Marburg and Sgalitzer, further investigations are necessary in order to elucidate the problem.—*T. Leucutia.*

Hell, Franz. Contribution to the roentgen therapy of pneumonias. *Strablentherapie*, 1929, xxxi, 786–796.

Twenty-four cases of pneumonia have been treated since 1924, by applying very mild doses of roentgen rays (15 to 20 per cent S.U.D., 40 cm. distance, 0.5 mm. Cu or Zn filter). In 19 cases no results were obtained; in 2 the result was doubtful and in only 3 was there a definite improvement. In very severe pneumonias roentgen therapy might be directly harmful through the indirect action on the heart produced by the irradiation effect. It is advised therefore that roentgen therapy for pneumonias be discontinued.—*T. Leucutia.*

Holst, Leopold. On the treatment of pneumonia with roentgen rays. *Ztscbr. f. klin. Med.*, 1929, cix, 698–713.

Thirty-three cases of croupous and bronchopneumonia were treated by roentgen rays (0.5 mm. Cu plus 1 mm. Al, 30 cm. skin target distance, 165 kv., 2 ma., 20 min., 15 per cent S.U.D., the treatment being repeated within two to three days). In 17 cases (50 per cent) there was marked improvement of the general condition, temperature and local process of the lungs; in 5 there was improvement of the general condition and of the temperature; in 5 of the general condition and local process of the lungs, and in 6 there was no improvement. The total improvement amounts to 81.8 per cent. The drop in the temperature was either by crisis shortly following the irradiation, or by lysis. In some cases following an initial drop the temperature remounted and following a second irradiation there was a permanent drop either by crisis or lysis.

Though it is not claimed that roentgen therapy produces a healing in all cases of pneumonia there can be no doubt that the course of the irradiated cases is less severe and is considerably shortened.—*T. Leucutia.*

Joly, M. Radiation treatment of cancer of the esophagus. *Presse méd.*, April 6, 1929, xxxvii, 450–453

The author gives a detailed review of the different methods of irradiation (roentgen therapy, radium therapy and combination of roentgen and radium therapy) employed in the treatment of carcinoma of the esophagus.

The opinion is expressed that irradiation is superior to gastrostomy since greater prolongation of life results. In employing radiation therapy it is important that gastrostomy be performed first and that the infection of the carcinoma be cleared up to a certain degree before starting irradiation. This, as a rule, is done by the application of lavages with 2 per cent sodium bicarbonate with the aid of the Faucher tube.

The roentgen therapy is applied by cross-firing the lesion through several fields (six fields of 12 × 12 cm., posterior, right posterior oblique, left posterior oblique, right anterior oblique, left anterior oblique and anterior) and by using the following exposure: 30 cm. skin target distance, 200 kv., 3.5 ma., 2 mm. Zn and 1 mm. Al as filters, a dose of 4000 R being applied over each of the individual fields.

In using radium alone the best results were obtained by the Guisez method (Guisez himself reported one cure of eleven years, 3 of five years and 2 of three years out of 180 cases treated). The method consists in the intraesophageal introduction of two or three Dominici tubes (20 mg. radium element) for four applications of twenty-four hours each with one day rest between the applications. In the method of Nabias the intraesophageal administration of radium is combined with external application of radium plaques along the spine and over the anterior thorax (six tubes being placed along the spine and five tubes over the anterior thorax, the total dose given amounting to 18,000 mg-hr.).

In the combination of roentgen therapy with radium the intraesophageal application of radium is done first (according to Guisez's method), this being followed immediately by the external administration of roentgen rays according to the technique indicated, with the exception that only 3500 R is given per field. *T. Leucutia.*

Kolta, Erwin. Roentgen therapy of diabetes mellitus. *Strablentherapie*, 1929, xxxi, 797–800.

Several years ago the author treated a case of diabetes mellitus by irradiating the pancreas. The result was nil. Since several articles have appeared more recently dealing with favorable results in the irradiation of the pancreas in diabetes mellitus, the author repeated his investigations by treating the pancreas in 5 cases of diabetes mellitus. The dose applied was ¼ of the skin unit dose, screened by 1 mm. Al and 0.4 mm. Cu, field 10 x 10 cm., three ports of entry, one abdominal and two dorsal. No changes were observed in the blood sugar or in the sugar or acid content of the urine, and there was slight deterioration in the

clinical symptomatology. It is advised that the therapeutic irradiation of the pancreas in diabetes mellitus be discontinued.—*T. Leucutia.*

Kruchen, Carl. Contribution to the roentgen therapy of lymphogranulomatosis with special consideration of the newer clinical results. *Strahlentherapie*, 1929, xxxi, 623–670.

Fourteen cases of lymphogranulomatosis were irradiated during the past three years. Five cases died and in 9 cases there was improvement. With regard to the doses applied the cases are divided into three groups according to the stage of the disease. The following dose is applied for the different groups: (1) Early cases, 50 to 80 per cent S.U.D.; (2) medium advanced cases with characteristic histological findings, 30 to 70 per cent S.U.D., and (3) very advanced cases with hyalinization and necrosis, fractional doses. The author believes that only the manifest lesions should be included within the field of irradiation.—*T. Leucutia.*

Leucutia, T. Roentgen treatment of pyogenic infections. *Viata med.*, 1928, iv, 277–284.

The systematic roentgen treatment of pyogenic infections is of recent date.

(1) In furunculosis, carbunculosis, staphylomycosis and panaritia, long wave roentgen therapy (50 per cent S.U.D.) is used with great effect.

(2) In the acute and subacute forms of pyogenic infections very small doses—the smallest doses applied in roentgen therapy—are used. Only 10 to 15 per cent S.U.D. is administered by applying the following technique; quality of roentgen rays 0.13 Å (200 kv., 1 mm. Cu, 1 mm. Al), 70 to 80 cm. skin target distance, 60 to 90 r. Larger doses are of no effect or are directly damaging. The treatment may be repeated within two to three weeks. In cases of abscess formation or sequestration, radiation therapy is supplemented by surgical procedures. In the chronic cases a somewhat larger dose is used and the treatment often is extended over a period of several months. All cases showing a progressive character and where surgical methods have failed to produce improvement should be submitted to irradiation.

(3) It appears that in septicemias (especially the puerperal form) irradiation with small doses (over the primary focus with the addition of one or two general fields) is of decided value.

(4) In chronic osteomyelitis roentgen therapy hastens the progress of healing. Irradiation is only applied as an adjunct to surgical procedures and with slightly larger doses.

(5) Some truly remarkable results are obtained in the roentgen treatment of gonorrheal arthritis. The sooner the treatment is instituted, the better the functional results. It is advisable to combine irradiation with the usual therapeutic methods such as immobilization, diathermy, vaccine therapy, etc.—*Author's abstract.*

Linton, James R., Marks, George A., and Smith, George Van S. The treatment of nonmalignant uterine bleeding by radium. *J. Am. M. Ass.*, March 23, 1929, xcii, 966–968.

Two hundred and fifty cases received radium treatment during the interval from 1917 to 1928. Forty-one of these cases had relatively small fibroids which were regarded as coincidental rather than the cause of bleeding. Six of the patients were not followed; of the others there were recurrences of bleeding in 3 that necessitated subsequent hysterectomy. The optimum dose was from 1000 to 1500 mg-hr. No later pregnancies occurred in this group. Regular menstruation was established in 6 patients, infrequent flowing in 4 and amenorrhea in 18. All were well six months to seven years after treatment.

Two hundred and nine patients were treated for uterine bleeding without demonstrable pathology. Thirty patients were not traced. One patient died the day after the application. There were 12 recurrences. Menopause was established in 112 cases. Menstruation was irregular in 5 cases and normal in 37. Sixty-nine patients had hot flushes, 29 had nervousness and irritability. The vaginal discharge was annoying in 11 cases. Only 30 patients were potential childbearers at the time of treatment and 13 of these had 20 pregnancies.—*E. P. Pendergrass.*

Marcus, Reinhard. Histological findings in two cases of carcinoma of vulva-clitoris first irradiated and then radically removed. *Ztschr. f. Geburtsh. u. Gynäk.*, 1928, xciv, 86–103.

From over two thousand microscopic sections of the tumors removed it was found that although the 2 cases represented different stages in the scale of radiosensitivity, the one carcinoma being of the adult hornified squamous cell type and the second of the unripe, poorly differentiated type, their response to irradiation was more or less identical. The conclusion is reached therefore that in cases of carcinoma of the vulva-clitoris the degree of differentiation of the cells is of little value as regards the final outcome of the disease.—*T. Leucutia.*

Nahmmacher, Hans. The problem of the treatment of uterine carcinomas and our results during the period of 1919–1923 and 1924 and 1925. *Strablentberapie*, 1929, xxxii, 51–80.

A statistical study of the five-year (1919–1923 and the three-year (1924–1925) end-results at the gynecological clinic of the University of Jena is presented. The series includes 379 cases, 257 of which belong to the five-year observation and 122 cases to the three-year observation period. The statistics were made following Winter's suggestion both for the absolute cure—representing the results of the total material seen in the clinic whether treated or untreated—and the relative cure—representing the material treated by radiation. The technique of the roentgen therapy is that of Seitz and Wintz. The radium treatment consisted in the administration of 54 mg. radium element with silver filtration for a period of twenty-four to forty-eight hours.

The statistics of the carcinomas of the portio and cervix—379 cases—are as follows:

(1) The absolute cure (according to Winter):
In the 5 year observation—17.8 per cent (257 cases)
In the 3 year observation—19.6 per cent (122 cases)
(*a*) Absolute cure of the operable cases:
In the 5 year observation—42.3 per cent (52 cases)
In the 3 year observation—78.5 per cent (14 cases)
(*b*) Absolute cure of the inoperable cases:
In the 5 year observation—11.7 per cent (205 cases)
In the 3 year observation—12.03 per cent (108 cases)

(2) The relative cure (according to Winter) in case of irradiation (roentgen rays plus radium; roentgen rays; radium):
In the 5 year observation—16.8 per cent (199 cases)
In the 3 year observation—16.6 per cent (102 cases)
(*a*) Relative cure of operable cases:
In the 5 year observation—34.7 per cent (23 cases)
In the 3 year observation—66.6 per cent (6 cases)
(*b*) Relative cure of inoperable cases:
In the 5 year observation—13.6 per cent (176 cases)
In the 3 year observation—13.5 per cent (96 cases)

(A) Relative cure in case of combined roentgen and radium therapy:
In the 5 year observation—16.4 per cent (158 cases)
In the 3 year observation—18.6 per cent (91 cases)
(*a*) Relative cure of operable cases:
In the 5 year observation—26.3 per cent (19 cases)
In the 3 year observation—66.6 per cent (6 cases)
(*b*) Relative cure of inoperable cases:
In the 5 year observation—15.1 per cent (139 cases)
In the 3 year observation—15.2 per cent (85 cases)

(B) Relative cure in roentgen therapy alone:
In the 5 year observation—16.6 per cent (30 cases)
(*a*) Relative cure of the operable cases:
In the 5 year observation—100 per cent (2 cases)
(*b*) Relative cure of inoperable cases:
In the 5 year observation—10.7 per cent (28 cases)
In the 3 year observation—0 per cent (7 cases)

(C) Relative cure in radium therapy alone:
In the 5 year observation—9.09 per cent (11 cases)
In the 3 year observation—0 per cent (4 cases)
(*a*) Relative cure of operable cases:
In the 5 year observation—50 per cent (2 cases)
(*b*) Relative cure of inoperable cases:
In the 5 year observation—0 per cent (9 cases)
In the 3 year observation—0 per cent (4 cases)

(3) Relative cure in operation: (*a*) operation alone; (*b*) operation combined with irradiation:
In the 5 year observation:
(*a*) 50 per cent (10 cases)
(*b*) 50 per cent (18 cases)
In the 3 year observation:
(*a*) 100 per cent (1 case)
(*b*) 50 per cent (2 cases)

(4) Relative cure in cauterization:
In the 5 year observation—0 per cent (6 cases)
In the 3 year observation—83.3 per cent (6 cases)
(*a*) Relative cure of operable cases:
In the 5 year observation—0 per cent (1 case)
In the 3 year observation—100 per cent (5 cases)
(*b*) Relative cure of inoperable cases:
In the 5 year observation—0 per cent (5 cases)
In the 3 year observation—0 per cent (1 case)

(5) Primary mortality:

(*a*) In irradiation—0.79 per cent (1919–1925)
(*b*) In operation—1.05 per cent (1919–1925)

The statistics of carcinomas of the corpus—44 cases—are as follows:

(1) Absolute cure:
In the 5 year observation—58.3 per cent (24 cases)
In the 3 year observation—55.0 per cent (20 cases)

(2) Permanent cure of operable cases (regardless of method of treatment):
In the 5 year observation—82.3 per cent (17 cases)
In the 3 year observation—77.7 per cent (14 cases)

(3) Permanent cure of the operable cases following operation:
(*a*) Operation alone:
In the 5 year observation—100 per cent (7 cases)
In the 3 year observation—75 per cent (12 cases)
(*b*) Operation and irradiation:
In the 5 year observation—70 per cent (10 cases)

In both the portio-cervix and corpus carcinomas the three and five year results show little variation.—*T. Leucutia.*

NEMENOW, M. On radiation therapy of myoma of the uterus. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1929, xxxix, 451–458.

Kriwsky gives the operative mortality of myoma of the uterus as 3 per cent. Arnstamm and Nowotjelnowa in tabulating all cases of uterine myoma collected from the literature which were treated by roentgen therapy (11,805 cases, of which 9407 were treated with roentgen rays and 2398 with radium) found a mortality of zero in roentgen irradiation and a mortality of 0.1 per cent in application of radium.

The clinical results in the cases collected were as follows: (*a*) up to 1914, of 1041 cases there was 91.2 per cent clinical healing; (*b*) from 1914 to 1919, of 2614 cases, 98.1 per cent clinical healing; (*c*) from 1920 to 1928, of 7146 cases, 97.99 per cent clinical healing. The author's series include 470 cases with 98.4 per cent clinical healing.

The author's technique from 1908 to 1921 consisted in fractional irradiation (112 cases with 98 per cent clinical healing), and from 1921 on, in the administration of a 30 to 40 per cent skin unit dose over the ovaries in one sitting by using 0.05 to 0.08 mm. Zn or Cu as filters with 180 to 200 kv. (362 cases with 99 per cent clinical healing). In the cases of the first period, in 26 per cent there was complete disappearance of the tumor; in 70 per cent reduction to half of the original size or more, and in 4 per cent no reduction. Of the cases in the second period, a complete reduction of the tumor was obtained in 37.5 per cent, a marked reduction in 59 per cent and no reduction in 2.5 per cent. Amenorrhea occurred immediately following the irrradiation in 42 per cent, after one menstruation in 29.5 per cent, after two menstruations in 27 per cent and after three menstruations in 1.5 per cent.

The following conclusions are reached. Roentgen therapy is the method of choice in the treatment of myomas of the uterus, leading to clinical healing in almost 100 per cent with a mortality of zero. The intensity of the climacteric changes produced depends on the constitution of the patient. It is a good plan to individualize the technique in different patients.

Modern technique leads to a greater percentage of total disappearance of the tumors following irradiation.

Contraindications: (*a*) pedunculated submucous or subserous myomas; (*b*) association of pregnancy, and (*c*) necrotic degenerating myomas.

Radium is especially indicated in the cases with intensive bleedings.—*T. Leucutia.*

REGAUD, CL. A comparative study of collum carcinoma, cancer of the mouth, mamma, and rectum from the point of view of radiotherapeutic methods. *Strahlentherapie*, 1929, xxxi, 671–690.

In analyzing the radiosensitivity of carcinomas, the following may be said for the different groups: (1) Epidermoid carcinomas. These include the squamous cell carcinoma of epidermoid origin such as skin, mouth, collum uteri and vagina which are also called epidermoid epitheliomas. The spino-cellular varieties are highly radiosensitive, in contradistinction to the basal cell varieties which are more radioresistant. (2) The epithelial carcinomas of the mamma. Very little is known with regard to the radiosensitivity of this group. (3) Adenocarcinoma of the rectum. The radiosensitivity of the adenocarcinomas of the rectum which form a rather homogeneous group is very limited. At the most a diminution in the size of the tumor with a temporary arrest in the growth can be produced by the application of radium. (4) The adenocarcinomas of the uterus. An example of the incurability of the carcinoma is represented

by adenocarcinomas of the uterus whether they originate from the collum or corpus. This is due to their marked radioresistance.

The varying radiosusceptibility of the above groups is fairly well explained by the histologico-physiological features of both the neoplastic and normal tissues. One may assume that continuous repopulation in the majority of the neoplasms as well as of the normal tissues is through the mother cells. The radiosensitivity of these mother cells is determined partly by the activity and the rhythm of division and partly by the secretoric function. The radiophysiologic factors in connection with the cell activity and rhythm of cell division are well known. The intervention of the secretoric phenomena, however, and their importance in the radiosusceptibility of the different tissues has attracted the attention of investigators only recently. As a result of these investigations one may say that all cells in the secretoric phase show a great radioresistance. Since both the normal and neoplastic glandular tissues may show alternating phases of cell division and secretoric functions, an irradiation might reduce or temporarily arrest the lesion through the effect on the cell divisions, but since the cells during their phase of secretoric function are radioresistant no entire destruction of the lesion can be obtained. By taking these factors into consideration as well as all other factors pertaining to the homogeneity of irradiation (such as grade of extension of the primary lesion, appearance of metastasis, location of the lesion and radioresistance of the tissues and organs above the lesion to be irradiated) one may establish the following rules with regard to the treatment of the mentioned groups:

1. Squamous cell carcinoma of the cervix and vagina. In Stage 1 which represents only 10 to 12 per cent of the total cases of carcinomas of the cervix coming under observation, one may expect a complete healing (by applying the radium within the cervical canal and the vagina) in a high percentage of cases. In Stage 2 cure by radium alone is obtained only rarely. Here a combination with deep roentgen therapy is of advantage. In Stage 3 because of the extensive involvement of the parametria and pelvic soft structures, radium application is of little value. A combination of internal radium application and external roentgen or radium therapy is the method indicated. In Stage 4 because of the possibility of fistula formation, marked necrosis, etc., radium is directly contraindicated and only external irradiation should be used.

2. Squamous cell epithelioma of the mouth. If the lesion is localized, results are favorable. However, if there is extension to the adjacent lymph nodes radiation therapy is of little value. In superficial carcinomas of the lip the application of plaques, in the deeper lesions the application of needles (1 to 5 mm. platinum needles) is indicated. In the carcinomas of the tongue as well as the infralingual and buccal carcinomas the needling should be combined with external irradiation. In carcinomas originating from the mucous membrane of the lower jaw, because of the possibility of radium necrosis, needling is contraindicated. In case of metastasis to the adjacent lymph nodes it is best to treat the primary lesion by irradiation and to apply surgical excision for the lymph nodes.

3. Mammary carcinomas. The method of choice in the treatment of mammary carcinomas is still radical operation. The question of combination of radiation therapy with surgery is not discussed.

4. Rectal carcinomas. Neither the local application of radium nor radium needling nor a combination of radium with deep roentgen therapy has led to a permanent cure in a carcinoma of the rectum. Therefore all operable cases should be left for surgical treatment. In the inoperable cases a colostomy should be performed and only later when there is appearance of pain, general deterioration, etc., should external irradiation be applied palliatively.—*T. Leucutia.*

Schmidt, Walter. On late injuries, chiefly in retarded growth, of the bone of adolescents irradiated for bone or joint tuberculosis. *Beitr. z. klin. Chir.*, 1929, cxlv, 440–456.

The series includes 200 cases treated by roentgen therapy between 1919 and 1925 for different forms of bone and joint tuberculosis, 90 cases of which were followed up. In 6 cases a marked shortening of the bones irradiated was observed due to retardation of growth brought about by the effect of the roentgen rays on the developing bones. On closer analysis it was found that all 6 cases belonged to the group of the first period in which more intensive radiation was applied, while none of the cases of the second period, where only moderate and mild doses were used, showed any disturbance in development. Comparative roentgenograms of the 6 cases are presented.

The conclusion is reached that the application of a massive dose over a bone in the stage of development may result in an arrest of the development leading to a marked shortening of the bone.—*T. Leucutia.*

SCHNEIDER, GEORG HEINRICH. On prevention of roentgen sickness following deep therapy. *Strahlentherapie*, 1929, xxxii, 205–209.

On the assumption that roentgen sickness is the result of a disturbed cholesterin metabolism due to injury of the parasympathetic component of the vegetative system, the author advises the administration of "colsil" tablets previous to the application of deep roentgen therapy. Immediately following the irradiation of an area two colsil tablets (0.1) are given and an additional tablet is given following each additional irradiation, four hours after the cessation of the irradiation. The method was applied in about 100 cases with satisfactory results.—*T. Leucutia.*

SCHÜRCH, O., and TSCHUDI, E. Experimental investigations on the healing of wounds electrocoagulated and treated with radium. *Strahlentherapie*, 1929, xxxii, 134–153.

The experiments were undertaken for the purpose of determining the method best suited for the treatment of carcinoma of the upper jaw. It was observed that the application of radium on the wound following a radical removal of the carcinoma resulted in a delayed healing. If the wound was produced by electrocoagulation and then treated by irradiation the time of healing was somewhat shorter.

The experiments consisted in the symmetrical excision of portions of the skin from the back of rabbits of 5 cm. sq. surface each. In one series of the animals radium was applied on the surface of the wound (three tubes of 6.66 mg. radium element filtered by 0.5 platinum for a period of two, four, five and seven days, this giving 1.2, 2.4, 3.0, 4.8, 6.0, 9.6, and 16.8 millicuries-destroyed per cm. sq.) and the healing observed. In a second series of animals the wound produced was first treated by electrocoagulation (1.5 mm. deep) and then the same amount of radium applied and healing observed. The controls consisted in simply determining the time of healing of the wound without any after treatment, and in the determination of the healing of the wound following treatment with electrocoagulation but without application of radium. In the wound without any after treatment healing was obtained in nineteen to twenty days, while in the wound treated with electrocoagulation alone the healing occurred within fifty-eight to sixty-one days. In the experiments the application of radium on the wound has considerably delayed healing (two, three and even four times the usual duration), while in the wounds followed by electrocoagulation and then irradiated the time of healing was somewhat shorter but still longer than in the control animals where the wound was treated by electrocoagulation alone.

The conclusion is reached that the application of radium on a fresh wound following operation for carcinoma of the upper jaw considerably prolongs the time of healing of the wound. If, however, the wound is produced by electrocoagulation and then radium applied the duration of the healing of the wound is shortened. It appears therefore that the method of choice is the excision of the carcinoma by means of electrocoagulation (radio knife) followed by local application of raduim. Such a procedure also leads to best clinical results.—*T. Leucutia.*

TOMÁNEK, FERD. On the treatment of malignant tumors by means of radioactive injections. *Strahlentherapie*, 1929, xxxi, 735–742.

The aim in radiation therapy is to destroy the neoplastic cells by doing as little damage as possible to the normal cells surrounding the tumor. The author went one step further and undertook to increase the vitality of the normal tissues around the tumor. This was tried by injecting radium emanation within the normal tissues in the neighborhood of the tumor. Such a procedure is well justified on the basis of experimental results already known. Lieber was the first to find that, following irradiation of the skin with an epilation dose, a total disappearance of the potassium in the irradiated tissues results. On the other hand the influence of potassium on normal cell metabolism is well known through Zwaardemaker's investigations. He found that when potassium is eliminated from Ringer's solution the tissues cease to function, while if potassium is replaced by radioactive substances the function returns, thus indicating that the potassium in the Ringer's solution can be replaced by radioactive elements. The experiments were repeated with Kronecker's pulsating frog heart, as well as on the frog aorta, and the same results were obtained.

It is evident that since irradiation produces a total disappearance of potassium within the irradiated area, as proved by Lieber, a replacement of the potassium by radioactive substances—in a manner similar to that performed in the experiments—may result in an increased vitality of the tissues irradiated. In order to prove this, experiments were carried out in humans with carcinomas of the tonsil and nasopharynx which as is known respond only poorly to irradiation. The cases selected for the experiments had lesions not larger than a hazelnut and were without metastases

to the adjacent lymph nodes. In 30 cases 1 mc. radioactive substance in physiological solution (1 c.c.) was injected within 0.5 cm. around the margins of the lesion. The injection was done simultaneously at three or four places. During an observation of six months there was no increase in the seat of the primary lesion and no metastases have developed, while all control patients showed extensive progress of the disease. In another series of 50 patients, in addition to the radioactive injections the primary lesion was treated locally by radium puncture by administering a dose 30 per cent less than is usual in such cases. All lesions healed and one year later there was no evidence of recurrence and no evidence of metastases. Considering that Quick obtained a disappearance of the symptoms in only 20 per cent and Regaud in only 22 per cent of the cases the 100 per cent result obtained following the combination of radium with radioactive injections is a remarkable accomplishment.

The procedure was also tried in cases of chronic roentgen ulcers. In 3 of the 5 cases treated there was healing of the ulcers.—*T. Leucutia.*

v. Büben, Iwan. Radium therapy of carcinomas of the vulva. *Strahlentherapie*, 1929, xxxi, 713–719.

During the period of 1918–1928 thirty-one cases of vulvar carcinomas were treated by means of a combination of radium and roentgen therapy. Two of these cases remained free of recurrence after six years; one lived four years, 2 lived three years; 3 lived two years, and 5 lived one year following the application of the radium while the rest died within one year. The dose applied was 1200 to 2400 mg-hr., repeated at six to eight weeks' intervals. Roentgen therapy was applied for the adjacent lymph nodes by administering within a period of six weeks three pigmentation doses (400 r in air). The conclusion is reached that the treatment of vulvar carcinoma is one of the most difficult tasks. A temporary improvement is obtained in the majority of the cases but a permanent cure belongs to the rare occurrences.—*T. Leucutia.*

v. Mikulicz-Radecki, F. A concentric attack on genital carcinoma with operation and actinotherapy. *Strahlentherapie*, 1929, xxxii, 39–50.

A combination of operation with different actinotherapeutic methods is advised in the treatment of all genital carcinomas. While two years ago the author, based on the material of the Stoeckel Clinic, expressed the opinion that all operable carcinomas should be immediately operated upon and radiation therapy should be applied only in the postoperative period, he has now changed his procedure to the effect that all carcinomas are given a preliminary treatment with radium. Such a preliminary irradiation in addition to the effect on the carcinoma also has a sterilizing effect in case of sphacelation of the carcinoma, thus preventing infection at the time of operation. The radium treatment consists in the application of an average of 6000 to 7000 mg-hr. divided over two sittings at three weeks' intervals (1500 mg-hr. intrauterine and 2000 mg-hr. by the vaginal route). The operation follows within six weeks the application of radium. During the period of convalescence then one series of deep roentgen therapy is given. The advantage of this "concentrated attack" is that all known methods are used within a rather short period. Due to the preliminary application of radium a larger number of carcinomas are operated upon than was the case with the method of primary operation.

A detailed technique is given for the treatment of the different groups of genital carcinomas (collum, corpus, vaginal, vulvar, urethral, and ovarial carcinomas). Since the method has been used for a period of only two years no opinion can be expressed with regard to its value.—*T. Leucutia.*

Warschawskaja, B. B. The metabolism changes in lymphatic and myeloid leucemia following roentgen irradiation. Preliminary report. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1929, xxxix, 458–468.

The nitrogen metabolism was studied in 12 cases of leucemia (5 lymphatic and 7 myeloid) over twenty-five to thirty days (first period, three to eight days preliminary to irradiation; second period, eight to fourteen days actual time of irradiation and third period, six to eight days following the irradiation). In lymphatic leucemia all lymph nodes, in myeloid leucemia chiefly the spleen, the sternum and the long bones, were irradiated. The doses applied were 50 to 60 s.u.d., 25 to 30 cm. skin target distance, 0.5 mm. Cu plus 1 mm. Al, Neo-Intensiv-Reform apparatus.

The following conclusions were reached. There is a difference of the nitrogen metabolism in myeloid and lymphatic leucemia both preliminary to and following irradiation.

In myeloid and lymphatic leucemias preliminary to irradiation the changes of the nitrogen metabolism consisted in an increased

retention of nitrogen followed by the excretion of incompletely oxidized nitrogen proteins (in lymphatic leucemia the changes being more pronounced). Following irradiation there was an improvement in the quantitative changes, the qualitative changes remaining the same.

The amount of uric acid excreted in lymphatic leucemia reached the upper limit of the normal value while in myeloid leucemia the amount was twice or several times that of the normal value. Following irradiation there was an increased excretion of uric acid, which in myeloid leucemia appeared during the period of irradiation and in lymphatic leucemia about one week following irradiation.

The phosphorus elimination, which as a rule represented average normal values, was considerably increased following irradiation.

The increase in the phosphorus and uric acid elimination coincided with the reduction in the number of the leucocytes following the irradiation.

A repetition of the treatment in the course of the same radiation series produced similar changes.

The residual blood nitrogen showed a greater increase in myeloid than in lymphatic leucemia.

The reason for the only temporary improvement of leucemia following roentgen therapy is to be sought in the inability to completely reestablish the normal nitrogen metabolism. —*T. Leucutia.*

Wood, Francis Carter. Radium and roentgen-ray therapy. *J. Am. M. Ass.*, March 9, 1929, xcii, 802–807; March 16, 894–897.

This article is a summary of the use of radium and roentgen therapy in the treatment of malignant and benign lesions. It is conservative and should be read by every radiologist. The author states that a safe general rule for the treatment of patients with malignant growths is to have only the inoperable types irradiated. Wherever possible a biopsy should be obtained. He stresses the fact that there are fewer skilled radiologists than there are good surgeons, and in addition one may do considerable damage if unfamiliar with the application of radiocative substances. Each group of malignant lesions is briefly discussed and the author concludes that the use of radium and the roentgen ray has unquestionably advanced the treatment of tumors of the skin and of the oral region. It has changed the situation in regard to carcinoma of the cervix. When a tumor is accessible and operable, surgery is the method of choice.—*E. P. Pendergrass.*

MISCELLANEOUS

Arkussky, J. On the iodine elimination of the organism under the influence of roentgen irradiation. *Strablentberapie*, 1929, xxxi, 806–811.

The importance of the influence of iodine on biochemical processes was studied in 70 cases of various malignant conditions by determining the iodine elimination following irradiation. Fifteen drops of official 10 per cent tincture of iodine or 0.035 to 0.04 per cent iodi puri was administered on an empty stomach in 100 c.c. milk. The patients were kept fasting for a period of three hours, then the urine was examined at different intervals for the next twenty-four hours with regard to the iodine content. The irradiation was carried out with doses of ½ S.U.D. (350 to 510 R) over a portal 6 × 8 cm. (23 cm. skin target distance) or 10 × 15 cm. (30 cm. skin target distance).

The following conclusions were reached: Patients suffering from malignant neoplasms (carcinoma, sarcoma, seminoma) as well as from lymphogranuloma malignum accumulate iodine in their organism. Following roentgen irradiation there is an increased iodine elimination, if the response to irradiation is favorable. The iodine, therefore, can be used as an indicator of the regressive processes within the tumor, a greater destruction of the tumor resulting in the elimination of a greater amount of iodine. In this manner the determination of the eliminated iodine is of a direct prognostic value. Further experiments are necessary for a complete elucidation of the problem.—*T. Leucutia.*

Arnaud, Marcel, and Ciaudo, P. On a biochemical procedure which may aid in the formation of osseous callus. *Compt. rend. Soc. de. biol.*, April 8, 1929, c, 889–890.

On the assumption that osseous metaplasia necessitates a local supply of calcium, the authors essayed a biochemical procedure for the purpose of bringing about a local deposition of calcium. The preosseous mucoid may be considered as a colloid which is capable of absorbing various ions, especially calcium ions, forming a rather loose combination with metallic proteins. By means of a phenomenon (which is to be determined later) the pseudo-solution of calcium is transformed, in the presence of silicium, into solid osseous callus. The silicium has a quasi-diastatic action on the mucous colloids resulting in flocculation. Thus while the colloidal silicium is the agent responsible for the flocculation the calcium

forms the substance flocculated. In order to substantiate this theory the authors injected a colloidal mixture of calcium and silicium (12 mg. calcium plus 0.02 c.c. Codex solution of potassium silicate in a 2 c.c. ampule) into the tissues around the fracture in 2 cases of pseudarthrosis which have developed following open operation and which could not be healed by any known method of treatment.

The first case was that of a fracture of the middle third of the femur in a man sixty-two years of age. The fracture in spite of an open operation five days following the accident failed to heal, and nine months later there was evidence of a pseudarthrosis. Following seventeen injections of Si plus Ca solution into the fractured areas (over a period of thirty-seven days) there was a clinical and roentgenological healing. In the second case there was a fracture of the middle third of the humerus in a man fifty-eight years of age. Approximation of the bony fragments by metallic bands (Parham) and application of cast over a period of forty days failed to produce healing. Following seven injections of Si plus Ca within the area of the fracture (during a period of fourteen days) pseudarthrosis developed and following an additional seven injections consolidation resulted. The treatment being interrupted at this period the pseudarthrosis reappeared and the administration of additional twelve injections finally resulted in complete callus formation.

The conclusion is reached that the formation of osseous callus can be chemically stimulated by the local administration of calcium and silicium within the fractured area.—*T. Leucutia.*

Bagg, Halsey J. Hereditary abnormalities of the limbs, their origin and transmission. II. A morphological study with special reference to the etiology of club-feet, syndactylism, hypodactylism, and congenital amputation in the descendants of *x*-rayed mice. *Am. J. Anat.*, March 15, 1929, xliii, 167–219.

Certain defects of the limbs occurring as congenital abnormalities in the descendants of irradiated mice are described. The investigation is based on a study of 5280 mice. The method of experimentation was as follows: Mice were irradiated over the entire dorsal surface with roentgen rays of 2½ inch spark gap, no filter, 10 ma., 12 inch skin target distance for 12 sec. exposure on each of five successive days. Twenty males and 10 females were treated and mated shortly after irradiation. Inherited defects were noted in the third and subsequent generations of animals that were descendants of treated mice. Since no such defects were found in over 2000 control animals it was assumed that the presence of abnormalities was brought about by an alteration in the germ plasm as a result of irradiation. These include various types of club-feet, syndactylism, hypodactylism, congenital amputation and polydactylism.

In addition to the above abnormalities of the limbs, blindness, absence of one or both kidneys and hydronephrosis were also observed in some of the animals, this indicating that there is a general tendency to arrests in embryonic development following the irradiation.

Club-feet with syndactylism and marked dorsal flexion were observed in 291 mice, with palmar flexion in 9 mice (the great majority of club-feet occurring on the left side), syndactylism without clubbing was observed in 9 instances, hypodactylism was found in 27 instances and congenital amputation or the entire loss of the distal portion of the limb at birth in 16 instances. Polydactylism was found in 93 of the first 432 mice observed. About two-thirds of the animals with polydactylism had an associated defect of one or both eyes.

In another series of experiments the prenatal condition of the animals was determined. By operative means a portion of the tail of a fetus in utero was removed without disturbing its development, thus marking the animal for identification at parturition. In other instances one or more fetuses were removed from the pregnant uterus without disturbing the development of the fetuses remaining in the uterus. By this method it was found that the earliest foot defect is associated with the formation of a blister-like bleb followed by escape of blood into the bleb and the formation of a localized blood clot. The extent of this pathological process and its anatomical location determine whether the later developing foot is to show either congenital amputation, clubbing, hypodactylism or syndactylism. Polydactylism may also be an expression of a localized arrest in embryonic development. The author describes in detail the reasons for suggesting this theory.

The conclusion is reached that the abnormalities of the limbs following irradiation with light doses of unfiltered roentgen rays are the result of arrest in the fetal development. These abnormalities are definitely inherited. They are recessive to the normal in inheritance. When considered as one of the manifestations of a general tendency to abnormal structure they approach the mendelian expectation in behavior.—*T. Leucutia.*

Bean, Achsa Mabel. A morphological analysis of the foot abnormalities occurring in the descendants of *x*-rayed mice. *Am. J. Anat.*, March 15, 1929, xliii, 221–246.

After a very detailed review of the literature dealing with the numerous abnormalities in the anatomical structure of the feet in mice, the author describes her method of procedure in the investigation of the foot abnormalities occurring in the descendants of roentgen irradiated mice. The investigation included at least 17 types of foot abnormalities, from slight degrees of departure from the normal type to grossly malformed members. These many types of abnormalities occurring simultaneously in the same stock of mice—without being observed in the control mice—seem to point to the fact that they are the result of arrests in fetal development (from different degrees of failure of blood and nerve supply) due to the irradiation.

The effect of the roentgen rays may be formulated as follows: (*a*) slight failure—slight degree of abnormality; (*b*) more pronounced failure—stimulating effect causing polydactyly, and (*c*) serious failure—gross abnormality. The technique of irradiation is not described. A detailed bibliography is appended.—*T. Leucutia.*

Bragg, W. Lawrence. X-ray optics. *Brit. J. Radiol.*, Feb., 1929, ii, 65–73.

The author shows the similarity, from a physical standpoint, between the use of light waves in studying the size and shape of an object through a microscope, and the use of roentgen rays in measuring crystals and other microscopic objects. A procedure for making such measurements is described and an illustration of the resulting "picture" is shown. This is compared with a diagram of the mathematical analysis of the same crystal structure. He concludes with the statement that the method is like "looking at a crystal with an eye that is sensitive to x-rays and through a microscope built for them."—*P. A. Bisbop.*

Chamberlain, W. Edward. Radiology as a medical specialty. *J. Am. M. Ass.*, March 30, 1929, xcii, 1033–1035.

The author in his summary states that the problem of lay laboratories will not disappear until the medical profession recognizes that radiology is truly a branch of medicine, and that it is fundamentally wrong to send patients to lay laboratories.

There will not be a satisfactory influx of young medical graduates into radiology, nor a satisfactory development of radiology in the hospitals, until the relations between the hospitals and radiologists have been improved. The hospital radiologist must be offered an opportunity for self-development comparable with that of his brothers in medicine and surgery.

Under the present scheme of things there are many instances of the exploitation of radiologists by hospitals. The amassing of profits by the hospital from the radiologist's services constitutes exploitation whenever such profits exceed what can be justified by the material outlay and investment in apparatus and space.

There is need for a revision in the fee schedules for radiologic services because most of those now in operation place the radiologist in the position of selling celluloid by the square inch instead of rendering a type of medical consultation service.—*E. P. Pendergrass.*

Desjardins, Arthur U. The status of radiology in America. *J. Am. M. Ass.*, March 30, 1929, xcii, 1035–1039.

This article is an excellent outline of the status of radiology in America today. Some of the problems that confront the radiologist and the hospitals which are interested in improving this branch are adequately discussed. The author feels that in order to obtain the maximum service from this field of medicine, the standards will have to be raised, the entire field of radiant energy should be placed under one head and there should be closer cooperation with the clinicians. When this has been done, the specialty will become more attractive to men of ability.—*E. P. Pendergrass.*

Martin, Charles L. The radiologic department in the hospital. *J. Am. M. Ass.*, March 30, 1929, xcii, 1039–1040.

The author outlines briefly the essentials of a radiological department. The success of a department depends upon the services of a highly trained radiologist. Such services cannot be obtained until hospitals make such a position attractive to the radiologist who wishes to do good work. The radiologic committee cooperating with the Council on Medical Education is making an attempt to formulate requirements to stimulate hospitals to elevate the department of radiology.—*E. P. Pendergrass.*

Chasin, Adib. The analysis of roentgenograms of the bony framework of the knee-joint (experimental work on normal cadavers). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1929, xxxix, 433–443.

Experiments were carried out on the bones of the knee-joint in order to determine the visibility of bone defects of different sizes in the roentgenogram. In a first group of experiments, part of the lower end of the femur and upper end of the tibia was sawed off and holes of different sizes were made within the bone. After replacing the sawed off parts roentgenograms were taken. In a second series of experiments the holes were made beginning at the surface of the bone and carried to different depths. The following conclusions were reached: Not all defects are visible in the roentgenogram. The localization of the defect, its size and form, the incidence of the rays and the state of the bony tissue (atrophy or sclerosis) are important factors in the visualization of different bone defects.

1. (*a*) Defects of 1.5 c.c. size located in the deeper strata of the femur and tibia are not visible either in ventrodorsal or lateral roentgenograms. (*b*) Defects of cylindric form of 1.5 to 2 c.c. size located in the deeper strata of the bone appear as irregular areas of slight rarefaction, the condition being better visualized when the incidence of the rays is in the longitudinal axis of the defect. (*c*) Defects of cylindrical form and of 2 to 3 c.c. size appear as areas of definite rarefaction, this being especially marked in cases with coexistence of atrophy of the bone. (*d*) Defects of irregular form and of a size larger than 3 c.c. appear as definite rarefactions, without, however, an accurate indication of their form.

2. The defects localized near the surface of the bone show greater visibility: (*a*) small defects 2 mm. deep or deeper localized to the superficial strata of the epiphysis are visible in either the anteroposterior or the lateral view. (*b*) In the visualization of bone defects of normal knee-joints in cadavers the superficial 1 to 1.5 cm. strata plays the most important part.—*T. Leucutia.*

Glocker, R., Hayer, E., and Jüngling, O. The biological action of different qualities of roentgen rays measured in R-units. *Strahlentherapie*, 1929, xxxii, 1–38.

Whether or not the number of R in different radiation qualities always produces the same biological effect is a much debated question. A number of investigators (Determann, Jacobi and Holthusen, and Hess) maintain that within the range of 60 kv. and 0.5 to 2.0 mm. Al and 185 kv. and 1 mm. Cu an equal number of R-units is necessary to produce an erythema on the human skin, while others (Glasser and Meyer, Wintz and Rump, Sievert, Jona) believe that there is a marked dependence of the R-units on the radiation quality. The question is analyzed by the authors in connection with numerous experiments on *Vicia faba equina* and the erythema formation on the human skin.

1. Irradiation Technique. (a) Apparatus. Stabilivolt S.R.V., Wintz stativ, Osram therapy tubes. (b) Quality of radiation. *Soft rays:* 80 kv., 3 mm. fiber (equivalent to 0.4 mm. Al), 0.07 mm. measured Cu half-value layer (in a second tube with different glass thickness 0.08 mm. Cu). *Hard rays:* 180 kv., 0.7 mm. Cu, 1.25 mm. measured Cu half-value layer. (c) Measuring apparatus. Wulf ionometer with Glocker chamber (thimble chamber of graphite-silicium-bakelite) standardized in R-units for all values of measurement.

2. Experimentation. (*a*) On *Vicia faba equina.* An average of eight horse beans (with two control beans) were irradiated *in air* by arranging the beans concentrically on an embroidery hoop frame of 17 cm. diameter between two layers of wet gauze. The beans, the root ends of which formed a circle of 1 cm. diameter, were placed in the direction of the central beam. The distance of the beans from the focus of the tube was 35 cm. and from the floor 125 cm. In order to prevent scattered radiation the measurement of the dose was carried out preliminary to and immediately following each irradiation which as a rule lasted from fourteen to seventeen minutes. The experiments consisted in twelve series with 180 kv. and 12 series with 80 kv., for each series 6 gradually increasing doses (200 R, 220 R, 250 R, 280 R, 310 R, 350 R) having been employed. A total of 5000 beans were used during the entire course of experimentation. Following the irradiation the beans were placed in wet sawdust, and kept at room temperature for a period of fourteen days, at the end of which time the effect of the irradiation was noted and photographs taken.

In a second series of experiments the effect of the scattered radiation was analyzed by placing the beans during irradiation on a wooden block of 30 × 30 × 30 cm.

(*b*) On Human Skin. In order to again eliminate scattered radiation small fields of 1.5 cm. were used by irradiating every patient through 2 to 6 fields with the rays of the two qualities mentioned. The surrounding tissues were protected by 3 mm. lead which was supported by a specially constructed rubber stand so as to eliminate the pressure of the lead on the skin. The measurements of the dose were carried out preliminary to and immediately following each irradiation. Twenty patients were irradiated with two doses (500 and 750 R), on the anterior surface of

the thigh or on the chest, while 18 patients were irradiated with three gradually increasing doses (360, 600 and 900 R). The reaction was observed both with regard to erythema and pigmentation with the apparatus of Schall and Alius, the observation being carried out for a period of sixty to seventy days.

(3) Results of Experimentation. (*a*) The horse beans showed changes in growth, in formation of lateral branches and in the appearance of new root ends. The doses up to 280 R produced a decidedly greater injurious effect with soft rays than with hard rays. From 380 R on the difference between the effect of the soft and hard rays was practically nil. The experiments with back-scattering (which were carried to only 60 per cent injury) revealed that the injury produced by the scattered radiation is on an average 29.7 per cent.

(*b*) The wave-like character of the skin erythema (Miescher) was confirmed. It was however found that there is also a rhythmic change during the different periods of the day similar to the variation in temperature. Thus the erythema is slight in the morning, increases gradually in the afternoon and again decreases in the evening. The maximum variation in the intensity of the erythema within twenty-four hours may reach the value of 100 per cent. As regards the pigmentation, it was observed that a slighter erythema occasionally produces a marked pigmentation while a severe erythema sometimes leads to only slight pigmentation. The changes observed in the two qualities of the radiation were similar to those observed with *Vicia faba equina.*

(4) Conclusions. In analyzing the relation between the biological and physical action of the roentgen rays, the authors arrive at the conclusion that the biological reaction is the result of the fraction of electrons suffering assimilation and not of the total electrons absorbed. This indicates that in case of an equal number of R the small doses of soft radiation are biologically more effective than of the hard rays (the difference in the experiments reaching 15 per cent). The dependence of the biological dose on the radiation quality is now experimentally proven for *Ascaris, Drosophila* and *Vicia faba equina.*—*T. Leucutia.*

HASE, H., KÜSTNER, H., and PIEPENBORN, J. The sources of error in standardization measurements by incorrect manipulation of the apparatus. *Strahlentherapie,* 1929, xxxi, 751–770.

The authors analyzed the various sources of error in the measurement of the R unit. The Küstner instrument was used for this purpose.

1. The influence of the position of the ocular of the microscope. A difference of as much as 21.2 per cent was found in reading the microscope with the ocular entirely pushed in or entirely drawn out, due to a difference in the magnification of the scale of the microscope. It is advised that the same position of the ocular be used for the different readings. In proving a radium preparation with regard to the constancy of its activity, it is best to use two standard radium preparations. Most of the measuring apparatus are now supplied with two radium standards.

2. The relationship of radium-seconds/roentgen-seconds is independent of external influences. This of course applies only when the apparatus is entirely protected and when the action of the radium and roentgen rays follows under entirely identical conditions. The only manipulation permitted is the insertion and the withdrawing of the radium preparation, the charge of the electrical machine and the determination of the dark effect. If the measurements of the roentgen and radium rays are carried out immediately following one another, the influence of the temperature, pressure, position of microscope, etc., may be neglected, the ratio radium-seconds/roentgen-seconds remaining constant.

3. Variation in the radium-seconds with and without diaphragm. The value of the radium-seconds is a few per mille smaller when using a diaphragm than without a diaphragm. Therefore measurements should always be made with the diaphragm.

4. Influence on the radiation of different objects placed behind the measuring apparatus but falling in the direction of the beam. Different materials such as lead, wood and brick were placed behind the apparatus during actual measurement and an increase of 3.6 per cent in the value of the radiation measured was obtained. Therefore it is advised that the apparatus be at least 20 cm. distant from the wall or any other objects in the course of the actual measurement. Since the metal support and the fluorescent screen of the apparatus may result in a similar error, it is advisable that they be removed from the outlet window of the measuring apparatus.

5. Influence of the mirror of the microscope and of the desiccation jar. When a great surface of the apparatus is exposed to the beam so that the mirror of the microscope and the desiccation jar are included within the field of the irradiation the scattered radiation resulting from these accessories is greater, the harder the rays and the smaller the

diaphragm. Thus the actual value for a diaphragm of 1 sq. cm. with 100 kv. and 0.5 mm. Cu is 1.4 per cent, while with 180 kv. and 1 mm. Cu is 12 per cent. The value is almost identical for the small and the large Küstner instrument.

6. Influence of the back-scattering of the stone wall in case of a large field. In using a very large beam of radiation so that part of the rays pass along the sides of the apparatus and irradiate a stone wall of 60 × 60 cm., a considerable back-scattering from the wall is obtained producing a considerable increase of the ionization within the chamber. The effect of the back-scattering is dependent on the size of the irradiated wall, on the hardness of the rays, on the diaphragm of the instrument and on the distance of the instrument from the wall. In the case of the large instrument only the anterior wall of the chamber and in the case of the small instrument a surface not larger than 8 cm. in diameter should be exposed.

7. Elimination of the dark effect. Under "dark effect" is understood a discharge of the instrument due to other conditions than the ionization produced by the rays. Such conditions may be a faulty isolation, radioactive influences, etc. The following formula is used for the correction of the time due to the dark effect both for the roentgen-seconds and radium-seconds:

$$T_{corr} = T \times \left(1 + \frac{s}{S}\right)$$

where T means time, S means the scale divisions measured for the radiation and s means the scale divisions measured for the dark effect.

8. The adjustment of the apparatus to the axis of the radiation beam is important. This is done either by the optical method or with the aid of a fluorescent screen.—*T. Leucutia.*

Kaye, G. W. C. Radiology, medieval and modern. *Brit. J. Radiol.*, Jan., 1929, ii, 3–28.

The presidential address delivered before the British Institute of Radiology, Nov. 15, 1928, consists of a lengthy historical sketch of the earliest medieval and later workers in electricity and physics. Brief descriptions of the work of William Gilbert and Sir Francis Bacon of the 16th Century are given. Of the 17th Century, Evangelista Torricelli, Otto von Guericke, known by his vacuum experiments, Jean Picard, the Hon. Robert Boyle whose outstanding achievement was his establishment of the law which bears his name, and Isaac Newton are mentioned. Of the 18th Century workers, Francis Hauksbee, William Wall, Stephen Gray, Desaguliers, Du Tay, Nollet, Benjamin Franklin, John Canton, William Watson and William Morgan, all made noteworthy contributions and discoveries. In later years in the field of roentgen-ray optics, the parallelism between roentgen rays and light rays has been completely established by the discovery of A. H. Compton, Siegbahn and others that roentgen rays show both total reflection and prismatic refraction. The discovery that roentgen rays could be totally reflected at fine glancing angles made it possible to use ruled reflection gratings for the production of roentgen-ray spectra. This method has been invaluable for exploration of the region of wave lengths occupying the former gap between the ultraviolet and the roentgen rays. At the end of the scale Coolidge has experimented with tubes excited by nearly a million volts. At the Pasadena Institute of Technology, a roentgen tube has been designed capable of being excited by a million volts. The work on the scattering of electrons is really a branch of physics which today is in a condition of extreme activity.—*R. S. Bromer.*

Kessler, E., and Sluys, F. The measurement of the gamma radiation in absolute r-units. *Strahlentherapie*, 1929, xxxi, 771–777.

An attempt is made to establish an absolute unit, identical with the r-unit, for the measurement of the radium rays in "distant radium therapy." This is done by use of the Behnken compressed ionization chamber with the modification necessary due to the greater penetration of the radium rays. The procedure is as follows: A large quantity of radium (several grams) is placed in a lead box, the walls of which are at least 20 cm. thick. The distance of the radium source from the ionization chamber is 5 meters. A special diaphragm is applied as a working aperture for the ionization chamber, consisting of a lead cylinder 25 cm. long, 12 cm. in diameter and with a central canal 20 mm. in diameter. It was calculated that by using this lead cylinder there is an increase of only 0.69 per cent in the total ionization due to the rays passing through the lead of the diaphragm. The ionization chamber is the same as that of Behnken except that it is of slightly larger dimensions and of thicker walls since it is built for a pressure as high as 100 atmospheres. The ionization chamber is provided with three electrodes, the middle electrode being connected to the measuring instrument which is a Piccard electrometer. By this arrangement the roentgen rays departing from the source

through the opening of the lead box enter by means of the lead canal of the diaphragm into the ionization chamber in the form of a pencil ray. The inlet as well as outlet of the ionization chamber is provided with aluminum and celluloid windows. The results of the measurement will be published in a later article.—*T. Leucutia.*

KRAUSE, WILLIAM F., and WHITAKER, LESTER R. Effects of different food substances upon emptying of the gall-bladder. *Am. J. Physiol.*, Nov. 1, 1928, lxxxvii, 172–179.

The authors point out first that detailed studies of the effects of a large variety of different foods on the emptying of the gall-bladder had not been made prior to their work. They have investigated the following substances: (1) olive oil, oleic acid, codliver oil, emulsified coconut oil, palmitic acid, iodized poppy-seed oil, egg yolk, butter and cream; (2) corn starch, glucose, polished rice and macaroni; (3) lean meat, egg albumin, Witte's peptone, casein, skim milk, dried and canned peas.

Three methods were used in this study; (1) post-mortem examinations of the gall-bladder and digestive tract of normal cats at varying lengths of time after feeding; (2) cholecystography in normal dogs; (3) filling the gall-bladder in normal cats with iodized oil and examining it by roentgenograms.

Their results with fatty foods show that there is marked variation in all the foods tested both in the degree of their absorption and in the amount of gall-bladder emptying occurring afterward, and that the highly saturated fats and fatty acids are less effective in evacuating the gall-bladder than the other fats studied.

Their results with carbohydrates show that pure starches caused some emptying of the gall-bladder in one instance among 13 animals examined and that a mixed carbohydrate food such as rice proved moderately effective in emptying the gall-bladder. They believe that this establishes the fact that glucose feeding cannot be used as a test for a normal gall-bladder in cholecystography.

Their results with protein foods show that lean meat is moderately effective in emptying the gall-bladder, while egg albumin produces slight but definite reduction in the gall-bladder shadow in some cases.

Because of the general impression that the odor of food may produce emptying of the gall-bladder, they fasted 6 cats whose gall-bladders were filled with iodized oil, until the animals were very hungry. They then subjected the hungry cats to the sight and odor of canned salmon for a period of one hour. The animals were all keenly interested in the food and some struggled to get at it, but in not a single instance was there any demonstrable emptying of the gall-bladder.

The conclusions the authors reach are: (1) that fats and fatty acids are by far the most active foods in emptying the gall-bladder, that there is great variation in this power among the various fatty foods and that the unsaturated fats seem more effective than the saturated; (2) that pure carbohydrates produce very little, if any, definite effect on the gall-bladder, and (3) that pure proteins cause slight emptying of the gall-bladder.

This report is concise and there are a number of tracings and reproductions of roentgenograms of gall-bladders in the various stages of motor activity which add much to the vividness of the impression made by this paper.

—*R. S. Bromer.*

KRUPSKI, A. I., and EISENBERG, M. F. On the influence of mild roentgen irradiation of the ovaries on the offspring in white mice. *Strablentberapie*, 1928, xxx, 527–543.

Experiments were carried out on 40 white mice with regard to the influence the irradiation of ovarian tissues has on the offspring. Since no exovulation dose is known for white mice, irradiations were carried out with 12, 24 and 36 per cent S.U.D., but is was found that even 36 per cent S.U.D. is far from being a castration dose. The offspring were observed for a period of nine months over three generations. All offspring have shown normal characteristics both with regard to size and development. The conclusion is therefore reached that mild irradiation does not constitute any danger with regard to late injuries to the offspring. However, in the application of roengen therapy over the region of the ovaries, a differentiation should be made between the ovarian dose, the dose of temporary sterilization which is 28 per cent S.U.D. (80 per cent of the ovarian dose) and between the mild irradiations with 10 to 15 per cent S.U.D. (30 to 40 per cent of the ovarian dose).—*T. Leucutia.*

LAURITSEN, C. C., and BENNETT, R. D. A new high potential *x*-ray tube. *Phys. Rev.*, Dec., xxxii, 850–857.

An attempt has been made to develop apparatus and methods of operation for generating and investigating roentgen rays in the region beyond 300 kv. The tube was designed to operate with the 1000 kva., one million volt transformers available at the California Institute of Technology. It was built up of 4 glass cylinders 12 in. in diameter and 28 in. long placed end to end, the glass being internally

shielded against electron bombardment. The phenomenon of "cold emission" is utilized for obtaining the electrons, the full potential being applied between water-cooled electrodes of suitable curvature placed a few centimeters apart. The electrons are pulled out of these surfaces by the very high electric field. A vacuum of 10^{-5} mm. of mercury is maintained by three stages of mercury diffusion pumps and an oil pump, the low pressure stage having a 5 in. diameter nozzle. The complete tube with supporting tower stands about 20 feet tall. Satisfactory operation has been obtained up to 750 kv., the voltage being limited by spark over from end to end of the tube. When operating at this voltage the radiation illuminates a roentgenoscope at 100 meters from the laboratory, or through a concrete wall 2 feet thick, and the human head casts only a slight shadow. Absorption measurements have been made with lead up to 2 cm. thick and have shown that secondary emission plays an important part in the photochemical action of these rays. The power input to the transformers amounts to about 300 kva. at this voltage.—*R. D. Bennett.*

Lee, Walter E., Tucker, Gabriel, Ravdin, I. S., and Pendergrass, Eugene. Experimental atelectasis. *Arch. Surg.*, Jan., 1929, xviii, 242–256.

The authors, working in the laboratory of research surgery of the University of Pennsylvania, have produced experimental massive atelectasis in dogs with the material removed by the bronchoscope from a patient who had postoperative massive atelectasis. In addition, the authors have produced massive atelectasis by introducing into the bronchus a synthetic preparation of acacia, which was especially made with the same viscosity as the secretions removed from the bronchus of a patient who had massive atelectasis. Another feature of interest in connection with these experiments was the incorporation of bismuth subcarbonate in the synthetic compound so that the obstructed bronchus was visible on the roentgenogram. These experiments represent the first report of the successful attempt to produce atelectasis in an animal with something other than an actual foreign body. The success of the experiments is largely due to the intraperitoneal use of sodium iso-amyl ethyl barbiturate which in a few minutes produces a deep narcosis and abolishes the cough reflex.—*E. P. Pendergrass.*

Loichinger, Carl. The history of the roentgenologic gastrointestinal examination. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1928, xxxviii, 1067–1072.

Loichinger calls attention to the fact that the first scientific work on gastrointestinal examination by means of roentgen rays was done by Rieder and that his method was so ingenious that in spite of the lack of sufficient equipment he was able to demonstrate the rugae of the mucous membrane of the gastrointestinal tract. Some of the roentgenograms taken by this method are presented and discussed briefly.—*T. Leucutia.*

Macklin, Charles C. The musculature of the bronchi and lungs. *Physiol. Rev.*, Jan., 1929, ix, 1–60.

Roentgen-ray work has shown that in inspiration there is an elongation and widening of the bronchial tubes, and in expiration a corresponding shortening and narrowing. The bronchial musculature, which embraces the mucosa of the airway continuously from the larynx to the alveolar mouths, is in a position to act in conjunction with the stretched elastic fabric, in the expiratory phase, to force out the air by shortening and narrowing the intrabronchial space. Corresponding relaxation during inspiration is postulated. The capacity of the bronchial tree is thus variable, and is identical with the "dead space;" this is controlled by the musculature, acting under the governance of afferent and efferent nerves belonging to the vagus and sympathetic. Contraction of the bronchial musculature must occur during relaxation of the motor inspiratory mechanism of the chest wall, and *vice versa*, and the innervation must provide for this antagonistic action.

Roentgen investigation, too, has demonstrated that a peristaltoid movement occurs in the bronchi when they are blocked by heavy exudates; thus the musculature is a safety mechanism acting to keep the tubes clear. This wave-motion possibly occurs constantly in free tubes, but in lesser degree.

The pharmacology of this muscle system is carefully studied and the actions of the various drugs classified. Pathological conditions, such as anaphylaxis, asphyxia, and asthma, are considered with relation to the muscle. The interstitial muscle, which is not directly involved in the structure of the bronchial walls, is reviewed.

The anatomy of the airway, particularly its complex terminal part (the bellows of Keith) is carefully described, for an appreciation of the function of the muscle is dependent upon an accurate understanding of its form.

A summary of this large mass of literature (some 492 articles appear in the bibliography) points to the conception of the lung as a muscular organ, which may stimulate a

reconsideration of the clinical problems centering around it.—*Author's abstract.*

Martland, Harrison S. Occupational poisoning in manufacture of luminous watch dials. *J. Am. M. Ass.*, Feb. 9, 1929, xcii, 466–473; Feb. 16, 1929, xcii, 552–559.

This special material is of vital interest to every radiologist and the original article should be carefully studied. The author has covered his subject in a meticulous manner and it deals with the history, symptomatology, pathology, prognosis, treatment and scientific literature of the industrial hazard concerning all workers with radioactive substances, especially those of the watch industry. All the previous evil effects of radiation recorded have been mainly penetrative in character by beta and gamma rays, by roentgen rays, or by inhalation of the emanation. The author states that for the first time it is shown that the deadly alpha rays have been known to act continually on such vital centers as the blood-forming organs.

From 1917 to 1924, 800 girls were employed in a factory in New Jersey. There were never more than 250 girls working at one time. Among these employees 15 known deaths have occurred in which radium poisoning was strongly suspected. It was proved to be the cause of death in 5 cases. The symptoms in these cases developed one to seven years after the patients left the employment. Thus it is shown that the mortality in this work compares with that of phosphorus poisoning among match workers which is 1 per cent in Great Britain.

The general principles of the preparation of luminous paint and the theories upon which the phenomenon of luminescence depends is discussed. Although a detailed preparation of the paint has never been published, Flinn has stated that the strength of the paints used has varied from 0.7 to 4 mg. of radium element or its equivalent, to 30–40 mg. of zinc sulphide. In addition cadmium 0.05, copper 0.001, and manganese 0.0002 per cent represent the impurities. It can be seen therefore that there are no constituents of toxicologic importance other than the radium.

The *mode of application of the paint* is carefully explained, stress being placed on the habit of the workers to point the camel hair brushes used in painting with their lips. These girls found this method quicker and more accurate. The author estimates that it is possible for a worker to ingest from 15 to 215 micrograms of radioactive substances during a week.

The *early deaths of which there were* 9 occurred in 1922, 1923, and 1924. No autopsies were obtained except in one case the body was exhumed five years after death and evidence of radioactive material was found in the bones. The causes of death were variously recorded as anemia, Vincent's angina, necrosis of the jaw, phosphorous poisoning, etc.

During this time possibly 50 girls were receiving treatment from dentists for various degrees of jaw necrosis. The first suspicion of the jaw necrosis being of occupational origin was recorded by Blum in September, 1924.

In 1924, the Consumers' League of the Oranges called the attention of the State Department of Labor to the objectionable fumes and the possibility of occupational poisoning. An investigation was made and the results were entirely negative. The U. S. Public Health Service briefly considered the matter, but did not make an investigation. In 1925 Hoffman made a report recording 5 deaths and 12 cases of jaw necrosis which he thought were due to the workers licking the painted brushes which probably contained mesothorium. Castle and Drinker made an investigation in 1924, at the authorization of the factory executives, being requested, according to the author, to make a report as to any evidence of zinc poisoning and to general hygiene of the plant. They found that the workers were being exposed to excessive radiation and they made recommendations for future protection of the workers.

The author had an opportunity to study 3 cases in 1925, all of which died, and autopsies were performed on all three, one of which was the company's physicist. All of the patients had a profound anemia and 2 had necrosis of the jaw. He reviews the findings of his own reports and those of Flinn, and calls particular attention to one case of osteogenic sarcoma of the scapula in a patient that had necrosis of various bones due to the deposit of radioactive material in the bone marrow. The illness and subsequent death of Dr. Von Sochocky, who was a technical director of the company, is described in detail and the author states that Dr. Sochocky is responsible to a large degree for the results of the investigations.

The litigation is briefly reviewed, as a result of which the cases were settled out of court and the company did not assume any legal responsibility that the cases arose from occupational poisoning.

The author's interpretation of the disease is that the anemias, jaw necroses and the various forms of crippling bone lesions

encountered in these girls were due to the ingestion of insoluble sulphates of radium, mesothorium and radiothorium which occurred when they were employed as dial painters and which were due to their habit of pointing the brushes in their mouths. Most of the paint swallowed passed through the gastro-intestinal tract, but small amounts were absorbed dy after day and were eventually deposited as insoluble sulphates in the phagocytic cells of the sinusoids of the reticulo-endothelial system and especially in the bones, spleen, and liver.

Only one patient that died had an appreciable amount of radioactive deposit in the lungs.

General Symptomatology. There are two types of cases: the early fatal ones and those in which death has not occurred.

The 15 known deaths had severe leucopenic anemia, severe necroses of the mandible and maxillae, buccal lesions and terminal sepsis. Symptoms were first noted one to seven years after the patients ceased working as dial painters.

In the latter group there are 5 known cases; necrosis of the mandible and severe anemia are not prominent symptoms in these cases. The disease is more chronic, being characterized chiefly by low grade crippling lesions of the bones due to a radiation osteitis set up by the deposits in the individual bones.

Special Symptomatology. Anemias. The deposits in the bones, because of the great insolubility of the sulphates of radioactive substances, act as fixed deposits from which they continually emit irritative rays that constantly bombard the adjacent blood-forming centers. Approximately 95 per cent of the rays coming from the bone deposits are alpha, the remaining 5 per cent consist of beta and gamma rays.

In the early cases, the anemia was not of the aplastic type, but the bone marrow was dark red in color. It was of a regenerative megaloblastic type. The predominating cell belonged to the erythroblastic tissues, many normoblasts and megaloblasts being present, many containing little or no hemoglobin. The fatty tissue was almost replaced by hyperplastic marrow. Megakaryocytes were abundant in most cases. Eosinophiles and esoinophilic myelocytes were very numerous. The occurrence of this hyperplastic marrow was puzzling as in cases previously reported the marrow was regarded as aplastic in type.

The author includes in his report all of the known cases of death from radiation, and a number of blood reports on workers around roentgen laboratories. The author feels that this problem has not been solved, but that any subsequent cases should be thoroughly studied clinically and by post-mortem examination. He deplores the fact that so few autopsies have been performed in workers dying with a disease that is so little understood and so important to all workers around radioactive material.

The *jaw necroses* are thought to be primarily due to radiation osteitis, similar to that occurring in other bones. Owing to the proximity of the mouth, which is the dirtiest part of the body, and to the fact that the jaw bones have the teeth imbedded in them, and because of the common occurrence of pyorrhea, the jaws are easily subjected to a superadded bacterial infection with subsequent necrosis.

Diagnosis During Life. The author feels that the most reliable method with which to detect the presence of radioactivity during life in this disease is by utilizing the expiratory air for the demonstration of either the presence of emanation by means of an electrometer or the presence of the alpha particle by means of scintillation methods. These methods are described in detail.

The diagnosis after death can be made by photographic methods, or with the use of the alpha electroscope and by quantitative estimation of radioactive deposits after chemical extraction. These methods are described fully.

The prognosis and treatment are discussed together in that there is no specific treatment. The only possible help may be the use of colloids which is to be published by Evans. The treatment therefore resolves itself into a purely symptomatic one till someone offers something more specific.

In conclusion, the author considers the future prophylaxis in the watch dial industry, and the compensation law of New Jersey.—*E. P. Pendergrass.*

Mischtschenko, J. P. Experimental results with regard to the influence of roentgen rays upon the function of the reticulo-endothelial system. *Strablentberapie*, 1929, xxxii, 154–162.

As is known the reticulo-endothelial system performs an important function in hematopoiesis, in the phagocytosis of colloidal substances and in the fight against blastomatous growths. Experiments were carried out in order to determine the influence of the roentgen rays on the reticulo-endothelial system by making use of the last two features, that is, the fight against blastomatous growths and phagocytosis of colloidal substances.

1. Experiments with homoplastic grafts. The Kritschewsky-Ssinelnikow (angiomyxo-sarcoma) rat sarcoma was used for this purpose. As determined by autopsy, this tumor yields metastases, chiefly to the lymph nodes and to the lungs, in 25 per cent of the cases. Following preliminary irradiation with increasing doses of roentgen rays the grafting of the sarcoma resulted in increased metastases: with 40 per cent S.U.D., 33 per cent metastases; with 60 per cent S.U.D., 100 per cent metastases; with 80 per cent S.U.D., 100 per cent metastases, and with 100 per cent S.U.D., 100 per cent metastases, the metastases occurring in practically all organs (even pericardium, kidneys, parietal pleura, mediastinum, thymus and ovaries). Thus proof is brought that the irradiation of the reticulo-endothelial system injures the fighting ability of this system against blastomatous growths. The injury is so pronounced that a dose as small as 60 per cent S.U.D. results in 100 per cent metastases.

2. Experiments with heteroplastic grafts. The same type of rat sarcoma was grafted in guinea pigs following irradiation with increasing doses and after the lapse of a certain time the grafts were reimplanted into the rats. While in the control guinea pigs the grafts have entirely absorbed within ten to twenty-six days, in the irradiated guinea pigs the absorption was much slower. In the animals irradiated with 40 per cent S.U.D., the grafts were still palpable at the end of the fifty-sixth day and in the animals irradiated with 60 to 80 per cent S.U.D. at the end of the seventy-second day. A tumor reimplanted in a rat at the end of the seventeenth day continued to show normal growth. Histological sections during the course of these experiments showed that while in the control animals there was evidence of granulation tissue (consisting mostly of fibroblasts and microphages) around the graft in the irradiated animals the granulation tissue was only scant. Thus proof is brought that the irradiation of the reticulo-endothelial system reduces the capacity of this system to destroy heteroplastic grafts.

3. Experiments with phagocytosis of colloidal dye substances. One of the most characteristic functions of the reticulo-endothelial system is the capacity to phagocyte great quantities of electronegative colloids. The experiments in connection with this feature of the reticulo-endothelial system were carried out as follows: A certain quantity of trypan blue (according to the body weight of the animal) was injected into the ear vein of rabbits and within one to two hours the concentration of the dye in the blood was determined colorimetrically. The determination was continued as long as there was evidence of dye in the blood of the animals. While in the control animals the dye in the blood appeared within one-half hour (0.007 per 100 c.c. plasma) and has entirely disappeared within 3×24 hours, in the animals preliminarily irradiated (with 100 per cent S.U.D. two hours previous to the injection of the dye), the quantity of the dye within half an hour following the injection increased to 0.01 per 100 c.c. plasma, and the duration of the total disappearance lasted for a period of over seven days. This proves that irradiation of the reticulo-endothelial system reduces the capacity of the system of phagocyting colloidal dye substances.

Since the reticulo-endothelial system plays such an important part in the fight of the organism against the spreading of a malignant tumor, a too intensive irradiation of the reticulo-endothelial cells in the light of the above experiments may lead to an extension of the neoplastic process.—*T. Leucutia.*